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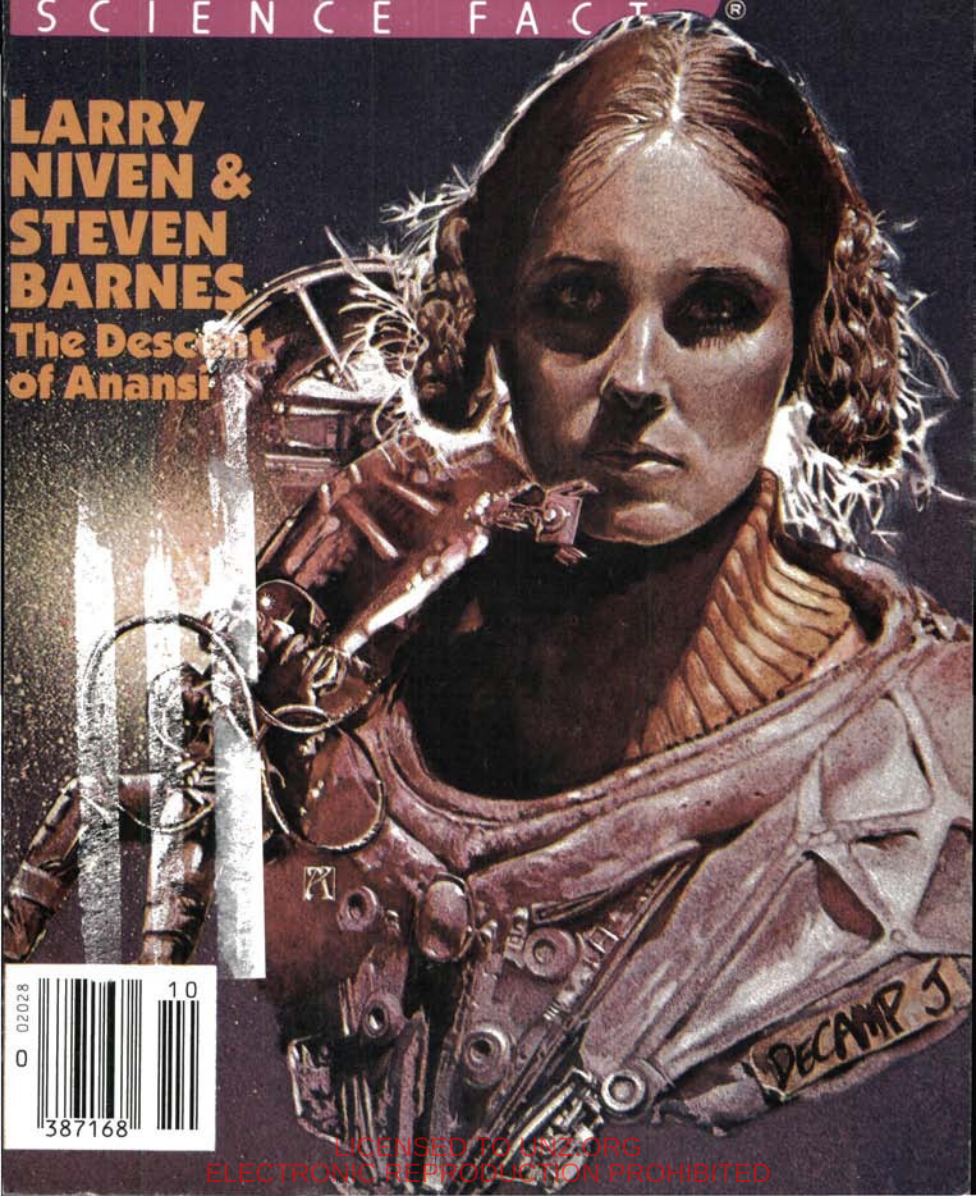

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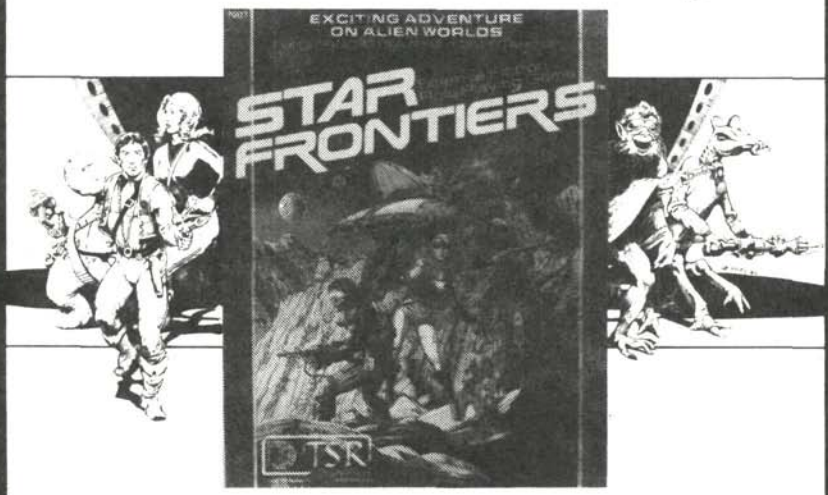

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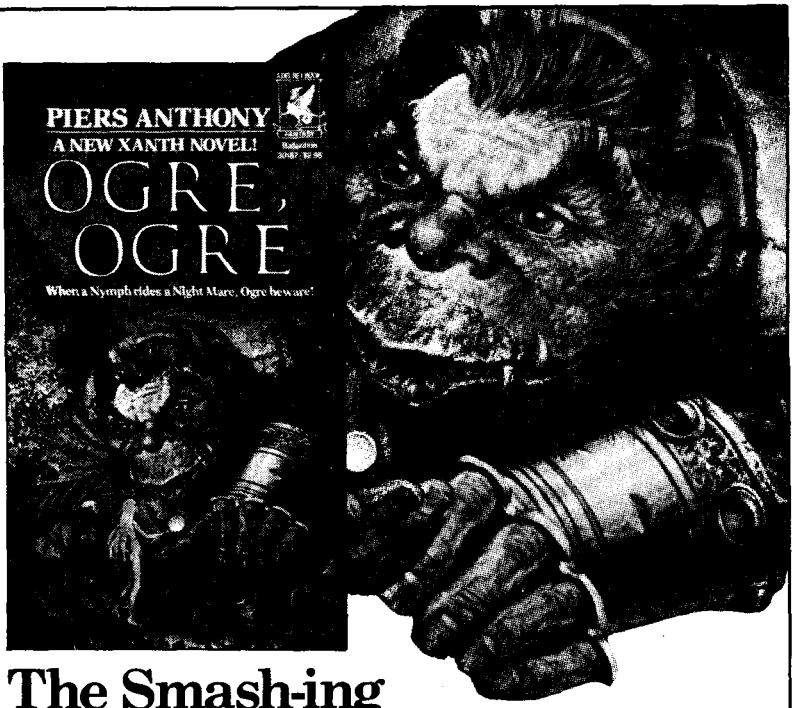

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Editorial by Stanley Schmidt

IDEAS BEFORE THEIR TIME

In June of 1965, I visited some friends I had not seen for a few years, but I may not have been the best of guests. Shortly after I arrived, I spotted the latest issue of *Scientific American* on the coffee table, with an intriguing cover for an article titled "Photography by Laser." I read the article on the spot, and my thoughts didn't completely leave it for the rest of the visit.

By now most people know what holograms are, but in 1965 they sounded like the wildest kind of science fiction: photographic plates which looked blank but, when suitably illuminated with a laser, produced three-dimensional images suspended in space. Not just stereo illusions, but *really* three-dimensional pictures, visually and photographically indistinguishable from the real object. You could even move your head and look around and behind objects in the picture. And you could shatter the plate and reconstruct the whole picture from each fragment. . . .

All very futuristic, but it was being *done*, right then, and this was the first I'd heard of it. Furthermore, it sounded surprisingly easy to do—maybe even within reach of a lowly undergraduate like me. There were no commercial holography kits then, but when I got back to school the following fall I managed to find a professor, Dr. Ernst K. Franke, who was as interested as I was and helped me wangle a private lab, use of department shop facilities, and even some "Special Problems" credits for trying to make holograms. When it worked, it created quite a stir, even off campus; nobody in those parts had ever seen anything like a holographic image.

Dr. Franke, being a good professor, didn't let me *just* play with homemade toys—he insisted that I also dig through the literature to learn what I was doing and what had been done before. That was enlightening in unexpected ways, because my literature search showed that holography research, now booming, had almost all been done in the last couple of years.

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Yet Dennis Gabor had described and demonstrated the basic principle at least as early as 1948!

Why did the concept sit around with very little development for more than a decade and then suddenly start growing explosively? I won't go into all the details, but Gabor's method had some drawbacks which made it impractical without a good source of highly coherent, monochromatic light. Before 1960, no such source existed. But when the laser came along, a few researchers realized it made high-quality holography relatively easy. They started doing spectacular things with it, and in very short order researchers in many widely scattered laboratories were jumping on the bandwagon.

This is but one of many examples of an idea which was introduced and then neglected, if not forgotten, because it first appeared at a time when some other piece of theory or technology needed for its development did not yet exist. In this case, the period of dormancy was only a dozen years and someone was quick to revive it when the missing ingredient became available. But how many others have not fared as well?

I came across one such example right in holography. Once the field started booming, people discovered a rapid succession of new techniques and applications. Interestingly, some of these were methods of making holograms or reconstructing images *without* laser light. It seems the laser was needed to make the process easy enough to launch vigorous development, but once that was underway one of its first results was an attempt to "throw away the training wheels." That effect is probably worth an editorial in itself, some other time.

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My point now is that one of these methods allowed making a hologram of an object illuminated with ordinary, incoherent, polychromatic light, using a two-stage process—*the first stage of which was published in a French journal in 1908!* The 1908 article described a method for taking a photograph through a "fly's-eye" lens and then using that photograph to produce a real image in space. Unfortunately, this image was "pseudoscopic," meaning (very loosely) that it appeared "turned inside out." Therefore the authors concluded that their technique was an amusing curiosity but of no practical importance, and for almost sixty years nobody gave it another thought.

Then somebody realized that the pseudoscopic real image produced by the fly's-eye photograph could be used as the subject of a hologram. A hologram produces two images, one virtual and one real. The real image produced by a hologram is pseudoscopic—and *a pseudoscopic real image of a pseudoscopic real image is a* non-*pseudoscopic real image of the original object!*

I haven't heard much about that process lately (but then, I haven't been in close touch with holography for a while). It may be that some other problem has kept it from being particularly useful—so far. The fact remains that it was shown to be capable of doing something which a sixty-year-old process could *almost* do—and that the unsatisfactory sixty-year-old process was an essential *part* of the later one that worked.

1908, by the way, seems to have been a good year for ideas which languished

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and then returned. It also produced a "hierarchical universe" model which showed up again—or at least something very much like it showed up—in discussions among cosmologists around 1970.

I know there are other examples, both theoretical and practical, of ideas which, for one reason or another, were not pursued when they first appeared. The notebooks of Leonardo da Vinci are full of detailed designs for kinds of machinery (such as military tanks and flying machines) which were not built until much later, whether because appropriate manufacturing methods were not yet available or because no financial backer could be convinced that they were practical and economical enough to be sensible investments. The 1892 *Encyclopedia Britannica* contains an article on "Atom" suggesting the wild idea that the law that two objects cannot occupy the same place at the same time may not hold at the atomic level — a radical suggestion at that time, but uncannily close to some of the key concepts of modern quantum mechanics.

When I think how many examples of this sort of thing I've already stumbled onto, and the sheer volume of scientific and technological literature and the impossibility of any individual's being familiar with much of it, I can't help wondering how many more of these things there are. The examples I've mentioned are, necessarily, ideas which have resurfaced after their dormancy. How many others, equally valid, have *not* yet been rediscovered?

It's hard to imagine a much more difficult topic for a literature search—but a good compilation of worthwhile work which has been buried and not yet exhumed could serve a very useful purpose, both in suggesting fruitful fields for new research and in avoiding wasteful duplication of groundwork already done. It might be the kind of project where thousands of heads are better than one. Many of you reading this have done research; probably some of you have stumbled across ideas that didn't get very far on the first try but could do better now, with the help of more recent developments. Of course, a lot of ideas have been buried not just because the means weren't available to develop them, but because they were really proved *wrong*. Those I'm not especially interested in hearing again (unless they happen to be things which present researchers are unwittingly repeating). But if you know about examples of the other kind—ideas which were born prematurely but whose time may have finally come—I'd be very interested in hearing about those. If I get enough good ones—with documentation so we can find the original reports—maybe one of these months we'll do an article on them. ■

● The great political tugs and pulls of the past 35 years have concerned the distribution of the golden eggs. In the 1980s and 1990s we must focus on the health of the goose.

Paul Tsongas

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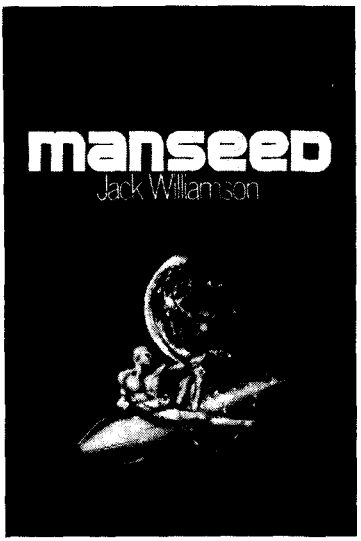

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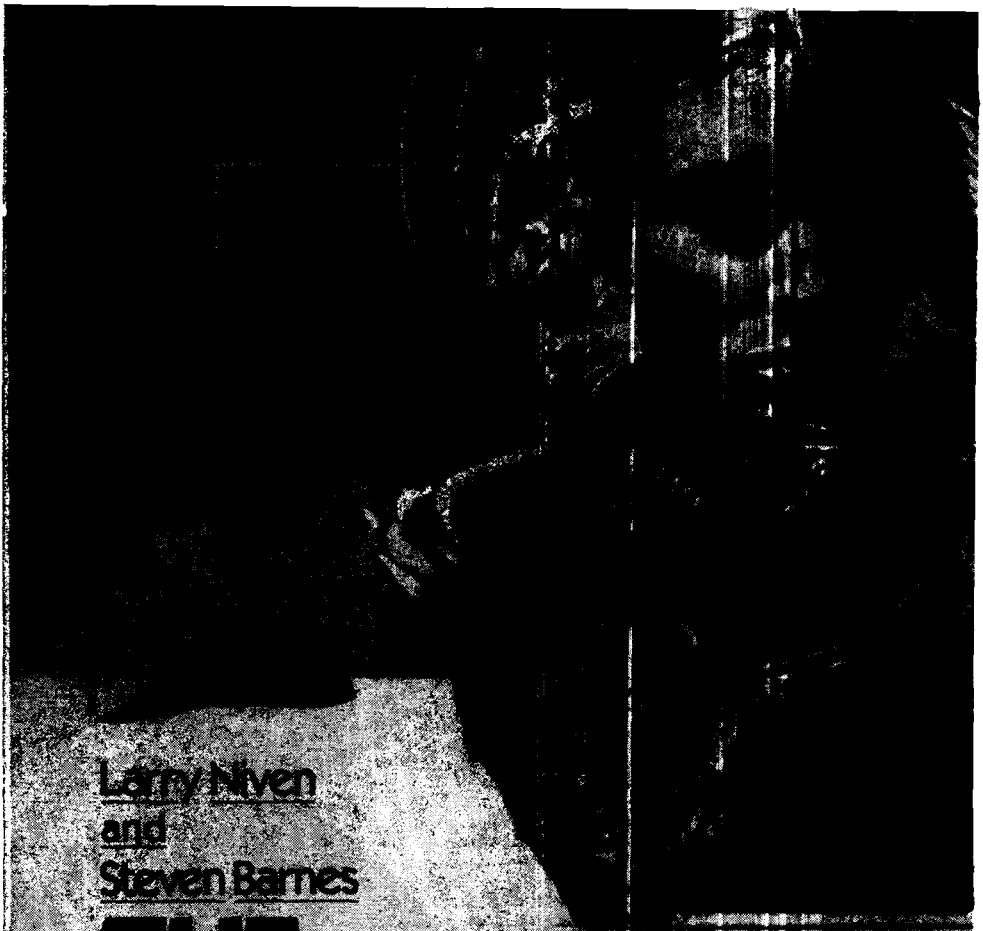

Larry Niven
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THE DESCENT OF ANANSI

When industry moves into space, it will become a valuable supplier of goods for Earth. But even geese who lay golden eggs have minds of their own....

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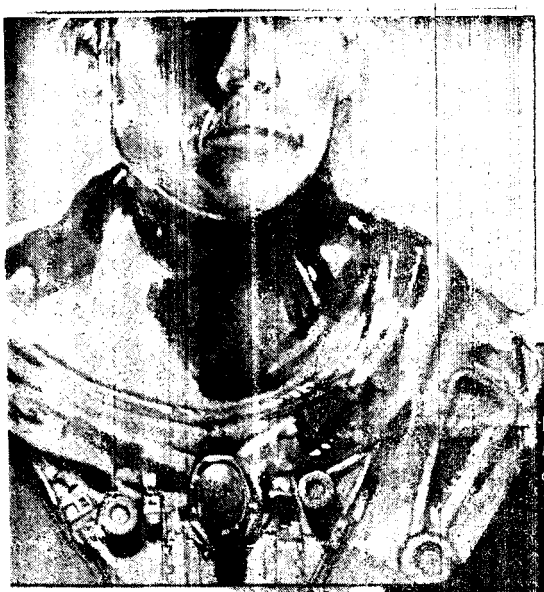

akey: Artifact

(Editorial Note: *It is not* Analog*'s usual policy to publish novel excerpts which are not independent stories; we will be interested in your reactions to our trying it in this case.*)

1. High Finance

The Brazil Tecimetal-Electromotores building was the second tallest in all of São Paulo, a glistening golden spire that sprouted from a cluster of drab five-story structures, an egotistical giant among dwarves.

Xavier parked his Mercedes in the underground parking structure and took Yamada up to the thirty-first floor in a public elevator. There they changed to a security elevator.

Jorge Xavier stood perfectly erect, and nearly a foot taller than his companion. His face was dark, his hair thick and fluffy and prematurely white; he was altogether a tailor's dream. Now his generous mouth was drawn into a slender line, his brows wrinkled in concentration. He asked—in English; he had learned that Yamada's Portuguese was poor—"You are sure of the amount?"

"Absolutely. Oyama Construction wants the cable at all costs. The Trans-Korea bridge will make their reputation."

Xavier slammed the edge of his palm into the elevator wall. "I know, I know. It is why we must have it. With the

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Stonecypher Cable in our hands, we can force Oyama Construction into a merger. Such a merger would combine the raw materials and manpower available to BTE with the technical resources and world respectability of Oyama Construction. With terms favorable to both sides, such a merger could be—'' he groped for words. ''I do not care what it takes. We will have that cable.''

''Your company president. Your Senhor Castellon. He will not match Oyama's bid?''

''Castellon is a sick old man. He spends half of the year in Caxambu, drinking the waters to heal a faulty liver. His problem is not in the liver—it is in the heart. He has no heart for a gamble.''

An electric-eye scan of the BTE executive's identification card admitted them to the fifty-fourth floor. Yamada stepped out and smiled reflexively at the pleasant softness of the carpet. He said, ''And you do?''

''I would not have brought you here otherwise. I, and a few others in my company, we have the heart. We are young, and strong. We will gamble.''

Yamada wondered, too late, if it had been wise to betray Oyama Construction to this man. He was suddenly very aware of what he himself was gambling. Income, reputation, honor, freedom . . . if he lost.

The BTE executive suite was as luxurious as practicality would allow. Muted music flowed from the inner walls, and many of the outer walls were gold-tinted plastic.

The receptionist was alert and smiling a greeting as the elevator door slid open. ''*Boa tarde, Senhor Xavier.*''

''*Boa tarde, Luisa.* This is Mr. Yamada. We will be in conference. Call Mr. da Silva, Mr. Costa, and Mr. Giorgi. Have them come to my office. *Obrigado.* Mr. Yamada? This way, please.''

Xavier led the slender Oriental down a corridor which ended in a huge oak-panelled door with the name J. XAVIER centered on a rectangle of brass.

There was a large conference desk in the front part of the office with a setup for videophone conferences. Yamada doubted that Xavier would want the contents of this particular conference broadcast over any line, no matter how secure.

''Please. Be seated. Drink?'' Yamada shook his head *no*, accepting the invitation to sit. Xavier busied himself at a small wetbar, coming back with a short glass of ice and clear liquid.

He sat across from Yamada, sipped his drink and gazed at him speculatively. Yamada felt naked, stripped to the skin and then flensed to the bone. Xavier probed and examined and weighed, finally laying the meat and organs back in place, slipping the skin back onto the body. No Japanese would have stared so.

The office door opened, and two men entered, followed a moment later by a third. One of them was Xavier's height, a fraction over six feet, but heavy in the stomach and thighs. He nodded without speaking. Xavier filled the silence. ''This is Mr. da Silva. Edson da Silva.''

The second was a small, neat man with a beard that had been trimmed to a razor point. He sized Yamada up in two intense seconds, then stretched out

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his hand. "Djalma Costa," he said. "Djalma with a *D*."

"Takayuki Yamada." Yamada turned to the third man, noting the limp, and the silver wolf's head cane that corrected it. "And of course you are Mr. Giorgi. Lucio Giorgi."

Giorgi was as tall as da Silva, but much thinner. His eyes were hollow, and the skin on his face was stretched taut over the bones, as if a long illness had stripped away the fat. Giorgi nodded with satisfaction and spoke with excellent, though accented, English. "I see that news of my accident precedes me."

"We were interested in your work on the Parana Dam project. Of course, when the scaffolding collapsed, we knew that the famous Giorgi had been the only survivor."

"I am perhaps too old to continue on-site inspections."

"If this project is as successful as we hope, we will definitely desire your expertise." They shook hands, and all five men were seated.

Xavier cleared his throat and slapped his palms on the table. "Well, Mr. Yamada. If you would be so kind as to share your information with us."

"Certainly." All hesitation had left him now. He swung his briefcase up to the table and dialed its five-digit combination. There was a sharp click, and Yamada eased it open and removed a thin folder of papers.

Yamada thumbed through it. "The item of interest is a cable recently extruded by Falling Angel Enterprises," he said. "Put as simply as possible, the cable is a strand of single-crystal iron filaments locked in an epoxy matrix." He looked up at them with a distracted look on his face. "It is eight-tenths of a millimeter thick and fourteen hundred kilometers long. All preliminary tests indicate that it is much stronger than Kevlar, at least ten or twenty times stronger."

His eyes slid over a page and a half of notes. "Suffice it to say that the . . . ah . . . delicate situation existing between America's National Aeronautics and Space Administration and Falling Angel Enterprises has severely limited buyers for the cable."

Da Silva nodded enthusiastically. "This is true. Pressure from the U. S. of A. has caused four nations to drop out of the bidding, Great Britain just this morning."

"Saving face," Costa laughed. "They knew they would be outbid. Quitting now earns them a few points in the eyes of the Americans." There was a twist on the word "American," as if he was sharing a private joke. "No. We and the Japanese are the only ones remaining in the bidding."

"I think that I can guarantee that Oyama Construction will win the bid. The Bridge project is entirely too important."

Xavier caught his breath. "How high is Oyama going?"

"One hundred and eighty million dollars."

There was a hiss of exhaled breath, and Costa cursed vividly. "He's insane . . ."

"No." Xavier said, his voice a solid weight in the room. "It is one of a kind. A thousand miles of the strongest cable ever produced by man. An option on the next five thousand to be produced.

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Oyama is taking the kind of gamble that Castellon would have taken twenty years ago, before he lost his *ovos*. The cable is unlike any material ever produced on Earth, now in orbit around the Moon, waiting for someone with the will to defy the stockholders and the U. S. of A."

The five men looked at each other, saying nothing. Costa watched Xavier carefully, watched him turn to Giorgi and measure his words before speaking. "Lucio. In your opinion, how important is that cable to the construction of the Japan-South Korea Bridge?"

Giorgi's hollow, pale face took on some color as he sat forward, fingers twining animatedly. "Mr. da Silva will correct me if I am wrong, but Oyama Construction is overextended financially. If the project is successful, Oyama will be in an exceedingly advantageous position. If it fails, or if the Bridge goes disastrously over budget, they will be in considerable difficulty. Certainly the present administration of the company would undergo considerable upheaval. Therefore, they need the cable. Even at the cost of one hundred and eighty million dollars, it is cheap. They will save money, time, and establish a permanent advertisement for their most advanced engineering techniques."

Xavier's eyes were cold and calm. "Well, then. If it is certain that Oyama needs the cable, then we can proceed with Phase Two. Again, Mr. Yamada?"

The Japanese swallowed, stepping over the edge of a mental cliff, trusting that there was water at the base. "I can supply you with course data for the Space Shuttle *Anansi*. With this information, you will know where the vehicle is during every second of its descent to Kwanto spaceport. If all the other elements are in readiness, interception will be possible."

"Excellent." Xavier took a thoughtful sip of his drink, eyes focused on the wall behind Yamada. "Giorgi. You are sure of your pilots?"

"Their loyalty is to me. To us. They

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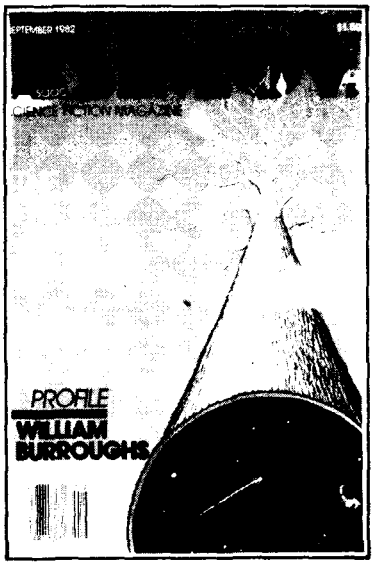

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understand their reward for efficiency and discretion will be . . . handsome. We will need 48 hours' start-up time."

"Costa? Your friends in the United Moslem Activist Front?"

"Ready and eager. It has been a dry time for them, and a headline of such magnitude will do much to revitalize the organization."

"I try never to denegrate our . . . allies . . . but one would think that these people would forget the Zionites and find themselves another war. It has been sixty years."

Xavier drummed his fingers on the table. He said, "It is a holy war. Soldiers in a holy war win or die. They do not seek new wars.

"Today is November the seventeenth. That gives us almost seven months. By that time, it will all be over, one way or the other. Well, gentlemen . . . there is the gamble: Disgrace and prosecution, or control of Brasil Tecimetal-Electromotores."

Again, there was no sound in the room, except for the subdued hum of the air conditioner. Then Giorgi cleared his throat and spoke. "I myself have always been a gambling man."

There was a murmur of agreement, and Yamada joined in quietly.

"Good," said Xavier. "Then, gentlemen: let us drink to our venture."

2: Grand Theft

A dull murmur wound its way through the audience, a murmur which could erupt into a roar at any moment. Thomas De Camp shifted uncomfortably and whispered, "I don't like this." His small dark eyes flickered around the room. "I really don't need to be here. All they need from me is my vote."

Janet De Camp squeezed his hand, brought her lips close to his ear. "Look at these people. Most of them don't want to be here, either. They just want it to be over, one way or the other." She pressed his hand again, then released it. Her ice-blue eyes were alive with eagerness, and the contrast to his own feelings was as marked as their physical contrast: her Nordic blood against his African and Oriental features, her five foot eight against his five and a half. The differences went deeper, deeper than he wanted to think about now.

A circular magnification screen glowed at one end of the Space Shuttle external tank that served as a meeting hall. Nobody had used chairs for free fall since Skylab. The hundred-and-fifty-foot tank was a maze of netting. One hundred and eighty barefoot audience members clung to the lines by fingers and toes, like flies in a spiderweb, with one difference: their feet all pointed in one direction, a tacitly agreed-upon "down."

The magnification screen was still blank: Fleming, the head of Falling Angel Enterprises, had yet to mount the podium.

There was a trickle of excitement from the back of the meeting hall, and De Camp turned his head in time to see Fleming and one of his aides gliding up the center safety line. He might have been going hand-over-hand up a rope, but no Marine fitness instructor ever floated "up" a line so effortlessly. Reaching the screen, Fleming unhooked

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his safety and nudged himself into position, refastening himself to the podium. His aide fastened herself to a nearby strand and handed him his briefcase.

Fleming cleaned his glasses, his gently humorous face seeming too long until he slipped them on again. "Good afternoon. I know that seems a cruel joke to those of you on the 2200 shift, but bear with an old man, eh?"

A tension-easing chuckle warmed the room as Fleming inserted a cartridge into the podium and flashed through his notes. A brawny Solar Satellite tech in front of the De Camps unhooked his fingers from the web and stretched his arms. "This isn't going to be good," he said to no one in particular. "Fleming is smiling."

Fleming took his usual position at the mike, hands braced at the side of the podium, pulling *down* to make his own gravity. "Can all of you hear me? Good, good." He arched his back, and long muscles flexed. He spent more time in the centrifugal-gravity of the administrative offices than anyone in Falling Angel. He looked every inch the patriarch, and the fatigue lines in his face only strengthened the image. "Well, I have just finished a short conversation with our friends in NASA." He let the ripple of laughter run its course. "Not totally to my surprise, they still refuse to deal with us. I believe that the most popular term being applied to us is 'lunatic pirates'."

A thin woman—her name escaped Thomas, although he knew she worked in Air Quality—raised her hand. "And why shouldn't they call us pirates?" she asked testily. "Everything that we have up here was paid for by the taxpayers of the United States. As far as they're concerned, we're robbing them."

"Miss Ellenshaw," Fleming said, adjusting his glasses, "the last thing in this world I intend is to turn my back on the American people. You must understand that the incorporation of Falling Angel was a matter of much debate and controversy before any announcement was made."

"You're still stealing." Her words were set in concrete, beyond argument, and De Camp was suddenly glad he had never had to requisition a recycler filter from her.

Fleming's face reddened. His teeth were set tightly, little muscles at the hinge of the jaw twitching. He had risked health and reputation to build Falling Angel from a single spacecraft in close orbit around the Moon, to a collection of clumped space junk, to one of the finest laboratory complexes in the world. He had supervised the expansion personally, scuffling and battling every inch of the way with the Earthlocked NASA honchos. Balding now, eyes weakened from long hours poring over computer displays, Fleming had personally suited up and led rescue operations, supervised the construction of the big mass driver in *Mare Crisium*, and for the past twelve years had poured his life and organizational genius into Falling Angel. At another time, this same roomful of people might have soberly discussed spacing Ellenshaw for those words.

Today, there was merely a whisper of assent.

"Stealing?" Fleming asked softly. "I think not. In the twelve years that

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Falling Angel has been in existence, we have repaid the original investment in our facility one and one-half times. Adjusting for inflation and interest on the original 'loan,' it is arguable that we still owe the United States a few million dollars. Believe me—every effort will be made to set this right. The truth of the situation is that unless we are freed from the present crippling bureaucracy, we will soon be unable to operate at all.

"Friends, we are a quarter of a million miles from the folks who do most of the voting. To us—to each other, here—Falling Angel is our whole world. To America, we are a few hundred people engaged in an exotic operation which has taken twelve years to break even. When the next budget cutback comes down the pipe, most voters will vote for something they can see and touch and understand. And one day, without any noise, Falling Angel will die, like so much of our space program."

Fleming gripped the side of the lectern and leaned forward, anger alive in his voice. "I'm an old man, and I've given my life to Falling Angel and the technology that built her. I'm too damned old to start over, and too damned mean to take this thing gracefully. We're going to show the American people that we can survive as a business, that we can make money—for *them*. If we can't appeal to their hearts, we'll try their wallets, but we're *not going to lose*. We need things that only Earth has, and Earth needs things that only we can make. We're Americans here, but we're something else, too. We're the future. If America doesn't believe in her future anymore, then maybe it's up to us to show her we're not dead yet."

At least half of the audience applauded loudly as Fleming pushed himself back from the podium and scanned them. Janet De Camp whispered to her husband: "Round one for the Good Guys."

The floor was opened for discussion, and controversy raged. Could Falling Angel truly survive as an independent? Could NASA or the American military retaliate?

The second question Fleming answered immediately. "If you ask that, you don't understand the situation. We aren't sitting on top of a diamond mine up here. At present we are considered a marginal enterprise. While we *do* have products we can sell, Congress will expect us to collapse without their support. When we don't, they may have some ideas about taking over, but remember: the real wealth of Falling Angel is its experienced personnel. At worst they might make an example of me and a few of my most conspicuous officers. The rest of you will be even more valuable to them than you are now.

"The American voter can see Falling Angel if he owns a telescope and knows enough to aim it right when we're rounding the edge of the Moon. *That* voter is fairly rare, and he's on our side anyway, and what does he see? A junkyard of expended Shuttle main tanks. Hardly something worth fighting over. What else? A fleet of six antiquated Space Shuttles, two of which NASA has already confiscated because they were on the ground, and three cesium-fueled ion drive tugs capable of moving them between Earth and lunar orbit."

There were a few more minutes of talk, then Miss Ellenshaw raised her

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hand and stood again. "Mr. Fleming," she said, "I move that we put this to a vote *now*."

He nodded. "All right. Seconded?"

The silence lasted too long for Thomas's comfort, and he raised a stocky arm. "Seconded."

"Then a vote it is. All in favor of independence for Falling Angel?"

Hands began to rise like sprouted seedlings, until just under half of the personnel had raised their arms. There was a quick count.

"Opposed?"

Fleming's assistant counted again, and handed her tally up to the administrator. He addressed them. "All post-essential personnel and lunar personnel have submitted proxies. The initialed vote sheets have been tabulated, and are available for inspection in my office. The official tally is: Independence, 147, Opposed, 142. The motion passes."

There were a few cheers, but also a rumbling undercurrent of discontent. Fleming raised his hand for attention. "Those of you who voted to remain under control of NASA may leave Falling Angel if you wish. We have made arrangements to ferry you back. This will relieve you of any fear of prosecution. Those of you who stay: well, I hope you know how badly we need each and every one of you, now more than ever. Let it be a matter between you and your conscience. Just remember—it's your future we're fighting for."

Fleming left the lectern to scattered applause, much of the audience already divided into percolating knots of controversy.

Thomas turned to his wife, unhooking fingers and toes from the net. "Well, that's that."

"We did it, Tommy." She grinned broadly. "Look at this. Are you sure you don't want to stick around? You won't find action like this out in the Belt." Her smile was a mask, her voice part wheedle and part sorrowful acceptance.

"I need quiet. Makes it easier to do the job. Anyway, I'll be wherever the ion drives are. I've done my part here."

Their eyes met and locked, and Janet tore hers away first. She tugged at him as he launched himself toward the safety line. "See you for dinner?"

There was quiet humor in the dark mongol face, humor that rose to a smile. "Sure. I'll be in the shop if you need me."

She nodded, watched him swim up the line with the smile fading from her lips. For a moment her vision misted, then she shook her head clear. "No time for that," she said fiercely, quietly. Then: "Damn it, there's no time for anything, anymore." Janet flexed the cramp from her fingers and joined the exodus, dozens of barefooted figures waiting for a place in line, heading for the locks.

3: The Auction

Most of those leaving the meeting hall donned pressure suits or took one of the connection tubes, but the administrator of Falling Angel had a scooter waiting. The pressurized three-man vehicles were in short supply, and generally reserved for the repair crews.

Fleming eased into the control seat

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and waited for his assistant to climb in next to him. Mrs. Kelly was a chunky woman on the far end of 40, married to one of the solar engineers. Bright, competent, and fiercely loyal to Falling Angel Enterprises. But she never moved quickly enough for Fleming's taste. After more than thirty months at the facility, she still wasn't used to zero gravity. No problems with it; in fact, just the opposite. Unless there was a specific demand for speed she seemed to linger over each separate movement, savoring it.

She had buckled herself in and sealed the door. Fleming broke anchor manually and they floated away, accelerating.

The universe was silence and razor-edged shadow as they cruised along the sprawling structure of Falling Angel. A score of shuttle external tanks was splayed out in orbit around the Moon, serving as a basis for the industrial complexes that served the needs of America, the Soviet Union, and the European Combine.

Suddenly Fleming's crow's-feet squeezed flat, and he pointed at a dimly lit, rounded object, like a water-smoothed rock equipped with tailfins. "Notation, Kelly. Find out why Strickland still has men working on the cable re-entry package. I was told it was ready to go."

She nodded, scribbling, glad that he had broken the silence. "What do you think about the meeting?" They were passing through a cluster of Shuttles. She ticked the names of the winged boxcars as they passed: *Susanoo*, *Lucifer* (*that* name had proven an ill omen: on its thirteenth descent to Earth, the landing gear exploded on impact. Only fast action by the fire crews, and a shock-absorbing restraint wall made of Dexter Stonecypher's "enhanced" fiberglass, had saved lives and cargo), and the newest addition, *Anansi*.

Fleming said nothing for a few seconds, only the flickering dim lights of the computer display bringing his face to life. He watched the spinning bulk of the exercise room pass to their right. "We'll make it. We'll be down to half strength, but the people who stay, they're the real workers. The deadweight just voted itself out." His hands played delicately over the controls, and his voice never wavered. It took someone very familiar with his ways to sense the bitterness in him, but Mrs. Kelly was that close, and more. "We can count on them. You'll see." His eyes never left the shadow-crested shapes rising beneath and around the scooter.

They went into an approach path for the administration buildings: a flat disk connecting three shuttle tanks. The tanks rotated about the axis of the disk, providing "gravity" for the offices. The center disk housed the filing and supply warehouse.

He docked without a bump, and Kelly sealed their door on, waiting for Safety to approve and admit them to the tiny airlock. She barely noticed the sensation of weight returning as she lifted Fleming's briefcase from the rear seat.

The alarm in Kelly's wristwatch buzzed until she flicked it off. "Looks like we're just in time," she said, helping Fleming from the scooter. "The calls are coming through."

"Good, good. Put them on hold. We'll be there in a minute." The inner lock opened and let them through. The

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hallways and corridors were largely plain, but not severely so. Kelly could remember infinities of bare plastic trim laid on foam steel. Now, the niceties of gracious living were creeping aboard.

Closer to the center of the hub the floor was carpeted in Velcro, but that was unnecessary out at the edge, with two-thirds Earth gravity to hold a traveler down.

The office section was largely deserted, which made the narrow hallways seem more spacious. It was a feeling to cherish and to dread. If this desperate plan didn't work . . .

Fleming was reaching for the doorknob when it slid away under his hand. Dr. Stonecypher popped his head out, bending so that his greying hair barely grazed the top of the six-foot doorframe. His thick eyebrows knitted in perplexity. "There you are, Benjamin." He checked his watch with poorly concealed irritation. "I was beginning to worry." He moved his towering frame aside to let them pass, moving with the strange, disjointed grace of a praying mantis. Dr. Stonecypher was one of the original Falling Angels, and held the record for time spent in null-grav, beating out the nearest contender, a Russian communications specialist in orbit around Earth, by several thousand hours.

He virtually lived in the Metallurgy and Special Projects lab he had built over the past fifteen years, spinning out the miracles that made Falling Angel what it was: the most advanced zero-gravity research and production facility in the world. During that time, he had undergone one of the rarer effects of long-term work in space. Unhampered by gravity's fierce and constant tug, fed a constant high-mineral diet to counteract the negative calcium transport often experienced by long-term astronauts, his skeletal structure had experienced a second anabolic stage. The bones were growing again. He was nearly seven inches taller than the Stonecypher who had matured on Earth, and the medics were frankly baffled as to when the 63-year-old metallurgist could expect it to stop.

Eight years older than Fleming, Stonecypher was one of the few people who addressed him by name, and the only man Kelly had ever seen upbraid him. Fleming took it well. There was only one Dexter Stonecypher, and his expertise in a very special field was irreplaceable.

"Come, come," Dexter said, shooing Fleming along with a thin-fingered hand. Stonecypher walked along behind him with the painstaking delicacy he always adopted on his infrequent sojourns into the centrifugal zone. "I still have to supervise mating of *Gabriel* and the cable pod. And oh," he added almost as an afterthought, "we're holding Japan and Brazil on the line."

Fleming took the briefcase from Kelly and took his position at the conference table. "Let's not fall apart now, Dexter. A bit of teasing never hurt a sale. If it's worth buying, it's worth waiting for."

"An unexpected result of overexposure to moonlight," Stonecypher growled to Kelly as he took his place next to Fleming. He looked down at the top of the administrator's head. "He's turning into a merchant. Some bizarre variant of lycanthropy, no doubt."

"Hush," Kelly said. "I'm bringing the line on. Ready?"

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"Ready."

"*I've* been ready for seven minutes."

Kelly hovered over the intercom console. "Three, two, one, *live*."

Ghostly images of two men flickered into existence, in two of the three empty chairs at the table. The slender, dark one was Jorge Xavier. The other was a solidly built Japanese whom Kelly recognized as Retsudo Oyama, the son of the founder of Oyama Construction.

"Gentlemen," Kelly said, using clear, careful diction. "Are you receiving us clearly?"

There was a perceptible delay before Retsudo answered her crisply. "Yes, thank you. Reception is very fine. And you, Mr. Xavier?" His English sounded more British than American.

"Yes, thank you," Xavier said at once. "We had a problem with resolution, but it has been adjusted." He seemed somewhat stiff and unspontaneous.

"Gentlemen: Dr. Stonecypher, the head of the team which created the cable, is on my left. Mrs. Kelly is recording. Do we have any opening comments?"

Xavier cleared his throat. "I would like to point out that the sale of the cable should be influenced by other factors than sheer weight of gold."

"Indeed it has, Mr. Xavier," Stonecypher said with infinite gravity. "The fact that only two of you are left at this stage of the bidding indicates that quite clearly."

"Excuse me. I didn't mean the political pressures. It is possible that BTE can make an offer based upon a mutually profitable future relationship. We have Shuttle launch and refueling capabilities, which you may find useful in your present situation—"

"We have already made arrangements with the Japanese government, Mr. Xavier." A trace of annoyance thinned Fleming's lips. "You may rest assured that these arrangements will in no way affect today's bidding. The outcome will be based solely on the highest offer. What Falling Angel needs now is liquid assets. The item in question is already packaged for re-entry, and can be available for shipping within ten hours. Shipping can be completed within five days, and will commence after the first third of the payment has been transferred to our bank in Zurich. We trust that this will be satisfactory. Dr. Stonecypher will accompany the cable personally to guarantee its safety."

Fleming looked from face to face. "Are there any further questions? No? Then let the bidding conclude."

A small white rectangle appeared in front of each holographic image and hovered there. "You understand the rules, gentlemen. Each of you will be allowed one bid, and one bid only. The highest bid buys the cable." Tension had eased some of the depth from his voice, making it higher and thinner than usual. "May I have your bids, please?"

Xavier's rectangle filled at once:

$120,000,000

Fleming nodded appreciatively. "Mr. Oyama, are you ready?" The Oriental could not see the other's bidding box, but still he gazed studiedly at Xavier. Xavier's remarks earlier: had that been trickery, to lull him into lowering his bid? If BTE topped Oyama by one dollar, the cable was theirs.

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Oyama's rectangle filled with a nine-digit number:

$176,000,000

Retsudo was poised on the edge of his seat, as if ready to fly or fight. His hands were knotted painfully tight on the desk in front of him.

"Thank you, Mr. Oyama. Mr. Xavier, I'm afraid Oyama Construction has topped your bid."

Xavier made a little bow in his seat. "Congratulations, Mr. Oyama. Perhaps another time, Mr. Fleming." His image fuzzed out.

If a ton of steel girders had been lifted from Retsudo's chest, his relief could have been no greater. "Now, Mr. Fleming. I can assure you that the first payment will be deposited to your account within forty-eight hours. May I ask that the cable be ready for shipment as soon as you have received word . . . ?"

The rest of the details—high finance and ground control—were relatively easy to work out, and within fifteen minutes Oyama had faded from the room. Fleming and Stonecypher grinned at each other. "We did it." Fleming's voice was muted with wonder. "A hundred and seventy-six million dollars."

"Even inflation doesn't bite that too badly. Falling Angel has definitely hung out the shingle." Stonecypher ran skeletal fingers through his thinning shock of white hair. "We need to make decisions now, though. We'll need the very best pilot for the cable."

Fleming glanced at Kelly, who raised an eyebrow and silently mouthed a single syllable. Fleming nodded and turned back. "That would be Janet De Camp. Her husband Thomas would be my choice for ion drive tech. They're both space crazy—wouldn't think of going back."

"Yes, Thomas. Good man. We've traded pawns a few time. Isn't he prepping one of the ion drives for the Juno mining project?"

"Right, that's *Gabriel*, the one with the thermonuclear backup motor. He's been working on the others too. We were lucky there. The ion drive components came up before the political situation came apart. NASA could have stopped those flights."

Kelly was fidgeting uncomfortably. "Boss? This isn't anything official, but in a community this size it's hard not to pick up rumors."

Stonecypher clicked his puzzlement, leaning forward at the table. "This has some bearing on Thomas's fitness to accompany the cable?"

"It might not affect his compatability profile. He and his wife are separating. Nothing hostile, just . . . well, Dexter, you know Thomas. Introvert. Lives in his machines. He's never been much of a socializer."

Stonecypher's long frame stiffened slightly. "I've never heard of his having problems with anyone. We're here to work, not socialize. De Camp is a worker. I can understand that."

Kelly spread her hands helplessly. "I'm not passing judgement. I'm just trying to put my finger on the problem. What it boils down to is that his wife Janet started playing the field. There are six men for every woman up here, and that's an awful temptation to a healthy girl."

"How serious is the rift?" Fleming asked.

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"They're being very civil about it. But he's heading for the asteroids, and Janet is staying in the Earth-Moon system. Separation, for sure. I don't know about divorce."

"And your judgement?"

"Thomas puts his job first. Always. We can trust him. Janet's every bit as much the pro; she just knows how to cut loose, and he doesn't."

"All right. I think we can let Janet choose her own copilot from whoever's available. And that will round out the crew. What ship? Isn't *Anansi* due for repairs?"

"Yes, sir. Cargo bay doors need realignment. The other shuttles are in Go condition, but *Haephestus* is still in Japan."

"O-kay. Four shuttles and only two cans, right? And the cans hold fifty-four passengers each. We can take our departures—"

"Deserters," Stonecypher corrected politely.

"—down in three loads. *Lucifer* and *Susanoo,* bring a can back and send *Haephestus*. *Anansi* goes with the cable pod. Tell Gomez that we want *Anansi* ready by the time Oyama's check clears."

"Yes sir. I'll get on it immediately." Kelly stood, in a smooth, graceful motion that took years to master. The trick was to thrust against Coriolis force *and* keep one's feet on the floor. She paused before leaving. "Sir?"

Fleming lifted a busy gray eyebrow.

"I'm glad Oyama got the bid. There's something about that man Xavier that bothers me."

Her boss merely laughed quietly before turning back to Stonecypher.

* * *

Janet De Camp stripped down to a light-green leotard and hung her pressure suit on the rack near the inner door. There was one other suit on the rack.

She poised on the lip of the lock and took off, sailing into the air like a competition diver. She caught the first bar of the jungle gym and twisted her body lithely, working through it with practiced ease. The exercise room was another shuttle tank, hauled up out of Earth's gravity well, fitted with an oxygen recycler and spun from one end. The gradient of weight return was sharp enough to provide a thorough and unique workout to those who used the monkey bars instead of the ladder which ran down the back wall.

Leg at full extension, she hooked her heel on a bar above her head and hoisted herself up with one leg, spun in a tight ball and caught another bar. Her performance would have been impossible under any but the weakest of gravities. She climbed and twisted "down" the bars, working against Coriolis force and increasing spin-weight. She turned a horizontal bar into a side horse, doing a quick series of leg circles and then a backward scissors.

She was beginning to perspire now. She descended the rest of the way as if she were working parallel bars, swinging up, then dropping to the next level, hoisting herself into a handstand—and banging her ankle on another bar.

Janet's grip faltered, and she fell a few feet, catching herself frantically with a grip that would have shattered her wrist on Earth. Somewhat shamefaced, she lowered herself the rest of the way, the returning weight pressing the bars into her bare feet. The monkey

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bars, welded to the sides of the tank, ended eight feet above the floor, and she dropped, favoring the bruised ankle.

Lazy applause praised her efforts. "Bravo. Wonder Woman displays another of her myriad skills." The speaker was a slender blond man with finely chiseled muscles. His features were delicate enough to seem pretty, except for his nose, which was a trifle too large. He was stripped to the waist and glistened with the sweat of exertion. He shook his head violently, and an expanding halo of droplets flew from his hair.

"I'll make it all the way, Marion. You'll see." She limped over to him—an exaggerated limp, certainly—and watched as he slid back under the handles of the exercise machine. He pressed the handles up against two hundred pounds of air pressure and pumped it twice. It went halfway up the third time, then with a despairing *whoof!* he let it clatter back down.

Janet applauded sarcastically. "Bravo."

"I've been doing this for almost an hour, if you must know." He sat up and wiped his face with his cotton T-shirt, gazing at her with narrowed eyes. "May I assume that you aren't here just for a workout?"

"I hear that you're leaving."

Marion swung one leg over the bench, sitting sideways, and mopped his chest with the shirt. "Is that question business or pleasure?"

"We need you, Marion."

His eyes were chips of green ice. "I never realized how impersonal a plural could be."

"Look. We're fighting for something you believe in. Don't try to tell that what happened between us changed your mind about Falling Angel."

He said nothing, but leaned away from her a bare fraction.

She tried to smile. "Will you fly with me? Just this last time?"

"I really can't, Janet." His face softened, and he seemed even younger than his twenty-eight years. "I . . . have assets in American banks. A savings account, Uncle Gavin's trust fund—they could be frozen or attached. I can't afford to stay, and I can't afford to help you get that cable down." She watched him without speaking, and at last he shrugged, pulling his shirt on over his sweat-slick torso. "I won't be surprised if you don't understand, okay?"

Without a backward glance, he headed toward the ladder.

"Marion," she called after him. He stopped, one hand on the bottom rung. "Would you do it if it were safe? *Would you do it if I weren't the pilot?*"

He rolled his shoulders under the pullover, turned to face her. "Maybe. Since it doesn't matter, maybe I would. Even if you were the pilot. But that's not the way things are, so why don't we cut the conversation, Janet?"

"I think we could swing it." she said carefully. She watched his eyebrows arch in disbelief, and hurried on. "Listen. We can list you as a deserter. One of the cargos of Earthbound can land in Japan a few days before us. You change places with their copilot once we've landed, and go back to America. They may suspect something, but not enough to stand up in court."

Hope flared for a moment in his face, and her heart lifted. He *did* care about

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Falling Angel. "What if it doesn't work? I stand to lose quite a bit."

"That will be our department. You help us get this cable down, and if anything goes wrong you'll find yourself with a numbered Swiss account in the amount of your losses. Please, Marion. I wouldn't trust anyone else to be with me on this run. We . . . *I* need you."

There was the embryo of a smile tugging his thin lips into a bow. He shook his head ruefully. "Damn you, Janet. You've always got everything figured out, don't you."

4: The Man With No Friends

The splintered brown expanse of the Elburz Mountains fell away from under the BOAC jet as it made its approach to Mehrabad Airport. Djalma Costa buckled his seatbelt and pushed his body back into the seat, gripping his armrests with moist hands. The Industrial Relations liaison of BTE had never enjoyed flying, had never trusted planes totally. The feeling of unease frequently blossomed into airsickness during the landing approach. He closed his eyes and breathed slowly, concentrating on the fact that within minutes he would be in Teheran.

Costa's contact met him as soon as he had passed through customs. "Welcome to Iran," the man said politely, making a shallow bow. "Mr. Hoveida sent me."

Costa nodded, only the barest spark of suspicion alive in his mind. "And who is Mr. Hoveida's friend?"

The man's light-brown face crinkled into a knowing smile. "Mr. Hoveida has no friends, sir. His partner, however, is Mr. Reza Mansur."

Costa nodded. "All right. Take my bags. I'll carry the briefcase."

The waiting car was a battered Chevrolet station wagon. Inconspicuous. Good. He slid into the front seat and waited for the driver to finish stowing the luggage. They moved out into traffic, and Costa closed his eyes, running through a mental file on Hoveida.

Born 1968 in Ma'ad, Jordan, he had attended the University of Amman and become involved in radical politics. He first came to the attention of Interpol in '87 as the result of a PLO bombing raid on an Israeli synagogue. He went underground soon afterward, surfacing in Afghanistan as an arms dealer, in Baghdad as a hired gun, and once in Paris, soliciting financial support for a new organization, the United Moslim Activist Front. Claiming to represent the interests of all Arabs, he gained backing from several sources—some said that Middle Eastern OPEC interests were heavily involved—and was suspected to have been behind some of the most audacious acts of terrorism of the 1990s.

It was known that he had acquired a critical mass of plutonium, with plans to blackmail a western nation, most probably the United States. Word had leaked, and the enforcement arm of the United Nations Nuclear Limitations Committee descended on his headquarters in Edmonton, Alberta. Spearheaded by the Royal Canadian Mounted Police, the operation had been a complete success—the plutonium recovered, the terrorist organization smashed. Only Hoveida had escaped.

Hoveida knew that one of three peo-

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ple had betrayed him. All three of them were close friends of his. Unable to determine which was the traitor, he had taken the only totally expedient course of action: killing all three.

Since that time, Hassan Ali Hoveida had been known as "the man with no friends."

Here, in Iran, Hoveida had found a new home for the United Moslim Activist Front. Officially denounced and outlawed by the Iranian Parliament, they had nonetheless operated out of Teheran for the past six years with a minimum of difficulty.

Djalma was jarred from his musing by a jolt as the station wagon pulled up to the curb. They were in front of a fairly modern two-story dwelling, by its weathering perhaps ten years old. It clearly showed the influence of Westernization on Iranian culture, being barely distinguishable from any suburban house in America.

He waited for the chauffeur to remove the bags from the back, then followed him to the house. There was a five-second pause after a rhythmic knock, and the door opened. He was led down a narrow wood-paneled hall decorated with hanging rugs and lit with a single dull bulb.

The hallway opened into a circular room where a plain wooden table sat, holding an electric lamp. There were three men in the room. He recognized Mansur by his cadaverous thinness and precisely groomed beard. Behind him stood a huge man with a discernible lump beneath his light coat. Bodyguard.

The third man sat at the table, paring an apple very precisely with a folding knife. He was light for a Jordanian, and his face was a calm oval. His shoulders were broad but slack, relaxed almost lethargically. Costa had met him twice before, and both times had been stricken by the lack of warmth in the room. Regardless of the temperature elsewhere in the house, Hoveida's presence was always like a draft of cold air.

"Sit down, please." Hoveida's English was heavily accented, a strong element of French mixed with the Arabic.

Djalma sat, laying out his briefcase and crossing his legs carefully. "I am prepared to offer you a half million pounds sterling for your organization's participation in this venture."

Hoveida nodded soberly. "As agreed. I believe that our combined resources can accomplish this thing."

"The money will buy much ammunition, many guns and bribes. There is no problem with manpower?"

"None. It is, after all, a holy cause." A flicker of grim amusement curled Hoveida's mouth in a smile.

"So long as the equipment arrives on schedule," Mansur said quietly, "there should be no problem with the firing."

A wedge of apple vanished into Hoveida's mouth, and he chewed thoughtfully. "Of course, it is good that the men understand that this spaceship of yours does indeed threaten us," he said. "If they didn't understand this thing, it might seem as if the money were a primary motivation." Djalma glanced at the bodyguard, a huge dark man with hollow eyes. The man was too tense.

"Let me explain again," Djalma said, taking the hint smoothly. "The developing nations of the world have always been stripped of their resources by the industrial nations. Many of us

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have based our economy chiefly on the exportation of materials and energy, and through great struggles, have forced the robber nations to pay us a fair price for our goods. Now they prepare to rape the asteroid belt, and a network of solar power satellites is under construction, which will soon ring the Earth.

"Perhaps the two best forms of storing solar energy are, one, using it to dissociate water into hydrogen and oxygen. The hydrogen can be liquefied and used as fuel. Two, use solar power to make methyl alcohol from water and air and garbage. Either method reduces the dependency of the industrial nations on petroleum products, weakening the economy of any oil-producing country, particularly in the Middle East.

"It is time to show America, Russia, and Japan that they cannot despoil the Earth, then escape to the stars. They must be shown their vulnerability as graphically as possible. The spacecraft of Falling Angel Enterprises provide an ideal target. Due to the present dispute between Falling Angel and America's National Aeronautics and Space Administration, Falling Angel has declared its independence."

Costa grinned wolfishly. "This means that they are no longer under the direct protection of the United States. We can attack them and America will shake her head and say: 'Isn't it terrible, the things that can happen to wayward children? Come back to the fold, and we will protect you.' Now is the time to strike, gentlemen."

Hoveida nodded, watching Mansur out of the corner of his eye. After devouring another slice of apple, he turned to the thin man. "I am satisfied with the money and the justification. The men will do as I say. The rest is your end, Mansur. It would be best to ask any basic questions now."

Costa had the distinct feeling that Mansur did not like him or trust him. It was in the slow turning of the head, the moistening of narrow lips with a brownish tongue. It mattered little. The man was a weapons and explosives expert, perhaps the finest who had ever gone "underground" in the Middle East. He had been responsible for the design of the plutonium device captured in Edmonton.

"I do not doubt," Mansur began, his accent so thick that Costa had difficulty distinguishing the consonants, "that you can obtain a Prometheus missile. The resources of Brazil Tecimetal and Electromotores are well known."

In shock, Costa looked to Hoveida, and to the guard who stood quietly against the wall. Hoveida laughed harshly. "No, little man. I didn't give your secret away."

"But then how—? No one was supposed to know—"

"I am not ignorant of international business affairs, Mr. Costa. I am well aware of BTE's recent bid for Falling Angel's products. Your bid failed. I can understand vengeance quite well." Mansur's head bobbed on his pipestem neck like a puppet on a string, and his colorless eyes shone with pleasure. "Did you really think that I would involve myself in a project of this kind without knowing all of the details?"

"Very well." Costa mopped his forehead. "But I trust that this information will go no further?"

"Certainly. As I was saying before

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you became so upset, I have no doubt that you can obtain a ground-to-orbit missile. I need to know how you plan to deliver it to our launch site."

The smile on Costa's face was an uneasy thing, held by force of will alone. He riffled through his briefcase until he found the papers he needed, and laid them out on the table. "Now," he began, breath rasping in his throat. "The Prometheus missile will be brought in by tanker through the Persian Gulf to Bandar-e-Shahpur. It will be contained in twenty-three boxes labeled 'machine parts.' The necessary officials have already been bribed or—" he glanced at Hoveida, who, expressionless, was slipping the last section of apple into his mouth—"removed."

He skipped to another sheet of paper, reading down a quarter of a page before continuing. "From there, it will be shipped by rail, north to Qum, and from there southeast to Ardestan. Then we will need trucks to relay the boxes to the launch site. You have kept the exact coordinates of the site a secret, although we know it is in the desert near Isfahan."

Hoveida had stopped moving, was totally motionless, and again Costa had the feeling that the room temperature had dropped. "That is all you need to know. It is actually more than you need to know."

Mansur broke the icy silence. "Your communications and telemetry personnel will be accompanying the missile?"

"No, only the missile crew will actually accompany it. The rest will come in by helicopter from Kuwait."

Mansur and Hoveida spoke for a minute in Arabic, then Mansur rose and left the room, his bodyguard following silently.

Hoveida grinned broadly, exposing a split tooth in the back of his mouth. "Come. We must make you at home. After all, you are to be our guest for the next several days. There is much work to do."

5: Earthbound

There were four seats on the command level of *Anansi*: three standard, and one stretched-out monstrosity to handle the stretched-out frame of Falling Angel's chief metallurgist. Thomas patted the older man's shoulder as he edged past. "Good to have you along," he said.

Stonecypher nodded. "I assume you brought your board?"

Thomas buckled himself into his own seat behind Janet. "You bet. And we've got a chess program in the on-board, so take your pick." He leaned forward to speak to his wife. "We weren't getting enough efficiency from the atomic plant."

"Everything's fine now, Tommy. Check the monitor." Janet leaned left in the command chair so that her husband could peek over her shoulder. Ahead of her, out the front window, were nothing but pinpoint stars and, low in her horizon, a blue-white half-disk Earth. She could feel the adrenalin beginning to flow, as it always did before a mission, regardless of its size or importance.

She glanced from Thomas to Marion and back again. Marion didn't feel that

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way about his work. And Thomas did! *Why can't I forgive him that?*

"*Anansi*, this is Falling Angel," the intercom hissed. "You have completed all test sequences, and everything here is Go. Comments?"

"Captain De Camp." She adjusted the sound level on her mike. "Everything in order here. Go." She glanced back at Stonecypher. He looked to be half asleep, but his straps were in place.

Fuel tanks, a swiveled motor, and an electromagnetic plate: that was a limpet motor. It weighed as much as a man and was half a man's size, and it was generally handled manually. It was relatively cheap, and very useful in free fall. Whatever you wanted moved, enough limpet motors would move it. There were twenty now on *Gabriel*. Ten more on the cable pod would drop it from Earth orbit to Japan.

A score of limpets fired, and the cable assembly moved away from Falling Angel. After a minute or so their carefully measured fuel ran out, not all at once; and as they did, the magnets cut off. The cable assembly left a trail of limpet motors behind itself, all joined by a hundred meters of safety cord. The last to go was a sled bearing two limpet motors and a man.

They watched the sled heading back, trailing dead limpet motors.

"We picked up a touch of spin," Janet said disapprovingly, and she keyed attitude jets. Her crew's bellies rolled with the peculiar motion. When it stopped, Falling Angel had grown small enough to be cupped in two hands.

"Ion drive in ten," Thomas said. "Janet?"

"Fine."

"*Anansi*, this is Falling Angel. We monitor all systems as Go. Have a good trip. Check back when you round the Moon."

Cesium vapor flowed into *Gabriel*'s motor system. Positively charged grids stripped electrons from the cesium atoms, then sent them fleeing away, plus-charges repelling each other. *Anansi* accelerated with imperceptible gentleness on a breath of cesium-ion breeze.

Its path wound out from the Moon, became an expanding spiral. Falling Angel monitored through relays. At the end of six hours Falling Angel had become invisibly small below them, the Moon had become a good deal smaller, and their orbit was cometary. If the ion motor failed now, the cable assembly would not return to lunar orbit. Its target was Earth.

"Bishop to Queen's Knight three," Thomas said. Stonecypher watched him move the magnetic piece, and a smile tugged at the corners of his mouth.

Stonecypher castled.

The next move was pivotal, and Thomas relaxed a moment to think; but he found his thoughts drifting along other lines. It was easy to lose himself in abstractions once the mission was underway.

Thoughts of Alaska were particularly close now, as he hovered over a game board in the forward compartment. In a week he would be in orbit around Earth, the closest he had been for months. He alone would not land. He would return to lunar orbit in that tiny cabin aboard the ion drive, and from there head out to Juno, a hundred and fifty million miles from Earth.

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To help the memory of Janet die away . . . or at least lose its sharp cutting edges. He frowned, and concentrated on the board in front of him.

"Who's hungry?" Marion said from the top of the ladder.

Thomas heard Janet's musical laugh, pictured her slipping off her headset and stretching, cool blue eyes alive with pleasure. "I feel like I haven't eaten for a week," she said.

"Good enough." Marion started down the ladder. "I'll see what's in the food locker." He saw Thomas and Stonecypher absorbed in their game, cocked his head sideways to get a better look at the board, then produced plastic envelopes filled with club sandwiches and Hershey bars. "Food?" Stonecypher smiled. Thomas nodded without looking up from the board. The copilot dropped off an envelope apiece and a pouch of cold milk, then climbed up the ladder to the flight deck.

After he was gone Thomas made his move.

Stonecypher watched his opponent place the piece, and chuckled. "You don't like him very much, do you?"

The small man chewed a hole in his plastic pouch and ripped it open. "It's your move." His eyes flickered up to the flight deck. He heard Marion laugh, and the barest trace of a grimace kissed his lips.

"Normally I wouldn't worry about you, Thomas," Stonecypher said, fingers brushing the ivory tip of a knight's mane. "But you're going to indulge an old man's nosiness—you're not letting it get to you, are you?"

Thomas's forehead creased in parallel rows. "Why do you ask?"

"Because you aren't thinking, youngster." He moved his knight. "Mate in three, I think."

Thomas savaged a great hunk from his sandwich, eyeing the board with his irritation giving way to humor. "Your game," he said, "and your point, too. I'll try to keep a lid on it."

Stonecypher nodded, tore open his own package and started to eat. He barely nibbled at his meal. Fatigue syruped his movements, making them clumsy, making a lie of the lightness in his voice. Thomas started to speak, to give warning, but he knew that part of that urge was the wish to give Stonecypher a taste of his own medicine. Unfair. The only thing that would relax Falling Angel's elder statesman was an opportunity to do something useful: a mental state Thomas understood perfectly.

When Stonecypher pushed the remains of his sandwich aside, and the plasticware was gathered for the dishwasher, Thomas unhooked himself from his seat. "Let me stow this," he said. "Then we can get some work done."

The thin face nodded. "Yes, it's time to check our cargo."

There was little sound, even from footsteps, as they moved to the back of the lower deck, shuffling carefully down a strip of Velcro flooring. Surrounding them were lockers and a good deal of working space, including plugs and attachments and mountings for instrument boards. In the rear was mounted the elaborate control board Thomas used to monitor and steer the ion drive. Next to it, equally elaborate, the flight controls that would guide the cable pod down through Earth's atmosphere. Nei-

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ther was equipped with chairs; just handholds and more Velcro rug.

Stonecypher glided to the cable pod controls, moving his praying-mantis frame with eerie grace. "Let's have a look." His hands played over the console. Color video images sprang to life: a not very interesting view of *Anansi*'s tiled belly, another of the ion drive haloed in the faint violet glow of its exhaust, both relayed from a camera on the pod's vertical fin.

"The pod's riding well," he said. "No vibration. No heat buildup."

"Good." But Thomas was watching Stonecypher's thickly veined hands, noting the tremble. He weighed his motivations, found them pure. "Dexter . . . you're not well, are you?"

Stonecypher blew through his lips, a sound of disgust. "When you get to be my age, it's a rare day when some part or other isn't acting up." He turned back to his work, a shade too quickly.

"I'm not talking generally. I've been watching you. Your hands shake, you have no appetite, your face is drawn. Were you checked out at Falling Angel?"

Stonecypher looked down from his towering height, imperiously or something like it. "Just what are you talking about?"

"I'm asking you if you have any business going down into Earth's gravity well. You'll have to take three gees to get out again, and I'm beginning to doubt you can take that safely."

A gnarled hand rubbed across a forehead that was suddenly damp with perspiration. He started to frame a sharper response, then sighed in defeat. "All right. All right, Thomas, I'm not well. Perhaps I shouldn't make this trip—" He waved off De Camp's attempt to interject a word. "Perhaps I shouldn't—if all I care about is my own life."

He ran a hand through thinning white hair, trying to find a way to make his friend understand.

"Falling Angel is my life. It used to be space. When I was a kid I read Heinlein and Doc Smith and Asimov and everything in between. I could foresee mankind spreading out through the solar system and into the stars, world after world until the stars themselves burn out—but I never thought I'd see it. Well, we're making it happen. I wish I could jump a thousand years and *see* . . . but in this age it's Falling Angel or nothing. This cable is our salvation. Someone needs to be here, right *here*, who understands everything about it. If that entails a certain degree of risk, then so be it. I placed myself under risk when I first became involved in the project. Things were a lot different in those days—we lost some good men and women. We all held a common dream, and we bet everything we had on it, and some lost."

"But you didn't have to come. You could have sent Mannering, or—"

"No, no, *no*. They are my assistants. Why are they my assistants? Because they are not qualified to run the department!"

"You've got to learn to delegate some responsibility—"

"Not with the cable. Not when it concerns the product I have spent *seven years* designing and extruding. Not when it spells the difference between life and death for Falling Angel. No!"

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Suddenly his voice was whiplash strong. "This is where I should be. I thought that you, of all people, would understand that. But if you don't, it's irrelevant. Whether you or anyone else understands doesn't matter at all."

"But Falling Angel needs you!"

"No. Not if I've done my work properly. If all goes well here, then Falling Angel has a new lease on life, and the younger people will have their chance to run things. Mannering is running things *now*, while I'm gone. The dinosaurs, me, Fleming—we won't matter. We got it going. The rest belongs to you. Now. What do you propose to do about all this?"

It was not instantly obvious that Thomas had lost his temper. "Oh, I suppose we'll have to turn around and take you back and start over after we load more cesium and more supplies. The conquest of the stars can wait a week and a half . . . no? *Dammit, Dexter!*"

Dexter was stunned speechless. It was as if his wallet had bitten his fingers.

Thomas went on. "No, of course we can't turn around. It's just . . . you're my friend. Maybe my only friend, and I don't have the slightest idea how to keep you from committing suicide."

"It's not quite so bad as that," the giant said quietly. "I've merely made a decision that here, with my cable, is where I belong."

At last the smaller man smiled, a neutral twitch of the lips that grew warm in the light of Dexter's calm resolve.

"Good," Dexter said, slapping him on the shoulder. "Now . . . if we are finished here, shall we rejoin our companions above?"

Thomas prodded Dexter in the middle of the chest with a stubby forefinger. "In eight hours. You're going to bed."

6: Course Change

A day and a half out from Falling Angel, Stonecypher was looking better. At dinner he volunteered to take their meal trays down to the compactor. He started to turn . . . turned too far, lost his grip on one of the trays. Thomas noticed his sharp intake of breath, the wide-eyed puzzlement, the way his face lost color. Thomas frowned but did nothing. Even after years in space, one somehow expects a heart attack victim to fall over.

Velcro slippers anchored Stonecypher's feet, but his body swayed like an undersea polyp while his mouth gaped and his fingers massaged his chest. Then the pressoreceptor reflex, a sympathetic reflex triggered by diminished arterial pressure, cut in and increased the efficacy of the unaffected heart muscle, giving Stonecypher respite from the immediate agony.

Janet and Thomas reached him almost simultaneously, steadying, comforting. Marion was there a moment later. Feebly, Stonecypher tried to push them away. "Damn it! I'm fine," he gasped. "Just need to catch my breath."

Marion was taking his pulse. "The hell you are. I think you're having a heart attack. Help me, Thomas?"

The metallurgist was hardly pretending to fight now: he needed all of his strength to breathe. They towed him

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headfirst down the ladder. He was still protesting while they hooked him up to the ship's diagnostic display.

"Damn it, Dexter," Marion said nervously, waiting for Falling Angel to respond. "You, of all people, just aren't allowed to get sick on us."

The radio came to life. Three minutes: not bad. "This is Fleming at Falling Angel. Janet, how is he?"

"I'm not dead yet." Stonecypher opened his eyes. "Better. Better now." Janet was studying the diagnostic.

The lightspeed gap was a second or so. Fleming wasn't as calm as he tried to sound. "Bilateral cardiac failure, triggered by stress and deconditioning of the heart muscle. Dexter, the records show that you haven't kept up your aerobic points."

One of the metallurgist's frail hands gestured helplessly. "I've been busy."

"But *Dexter*—" Fleming caught himself, then spoke more softly. "All right, Dexter. We can talk about it later. The main question now is, what do we do with you? We *can't* let you go down to Earth."

Color came back into Dexter's face. "You don't have any choice and, and it's stupid to even consider turning back—"

"Dexter, your *life*—"

The ailing man cursed, shaking with his frustration. "Fleming, if you do anything that impedes Falling Angel, don't you dare think you're doing it to help me. I'll be fine. You just get the cable pod into the Sea of Japan, and take *Anansi* down so we can deliver the other tools, and this old heart will heal just fine." His outburst seemed to drain him, and he sank back, coughing.

Thomas opened a small package into a silvery strip. He pulled it through the elastic lines that webbed his patient, then opened it further. It was a thin, heat-reflective blanket. Thomas spread it out beneath the web, tucked it around Stonecypher's chin, then his legs; his thin, knobby feet protruded out the far end, and Thomas cursed under his breath. He turned it into a wan smile. "Is there *anything* about you that's standard?"

Stonecypher tried to smile, gulping air. "You have to make allowances for genius."

Thomas tucked the edges in. Janet saw the tension shaping his round dark face into planes and angles. Stonecypher closed his eyes and breathed rhythmically, trying to relax.

Thomas took the microphone. "What are the chances of his condition being aggravated by descent into Earth's gravity well? Even if he lived through it . . ." Suddenly he didn't want to say the words. Stonecypher looked to be asleep, but he knew that within the still body was an active, worried mind. Whispering would make it worse.

Again, there was silence on the radio. Then Fleming said, "I don't see that we have a choice. Unless— Let me work on something."

Without opening his eyes, Stonecypher growled, "You don't have any choice at all. Let's stop this idle chatter and get on with our work. Or does anyone but me remember what that word means?"

"We know." Thomas was thinking hard. "But we do have an option. We can deliver the cable pod, then take Dexter home in *Anansi*."

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Marion looked up, but Janet shook her head. "Thomas, *Anansi* doesn't have fuel to reach the Moon. We can maneuver in orbit—"

Marion jumped in with, "Can we use *Gabriel*? Without docking facilities?"

Thomas was nodding. "Shouldn't be a problem. That's what an ion drive tug *does*: pushes a shuttle between the Earth and the Moon. Docking facilities . . .hell, we'll just glue the push-pad to *Anansi*'s belly with the molecular glue in the cargo bay. God knows it's strong enough."

Fleming's radio voice said, "I thought maybe we could send you another shuttle to take Dexter home, but it's no go. *Haephestus* is ready to go, but the tugs are tied up pushing *Lucifer* and *Susanoo*. *Lucifer* and *Susanoo* were launched from Ryukyu five days ago. They're almost back to Falling Angel, it'd take a week to send one of them back. There's nothing to bring him home except *Anansi*."

Stonecypher inhaled sharply. "The Japanese won't like that—"

"Screw the Japanese. They'll have the cable, they can wait two weeks for the rest. How fast can you get him home?"

Thomas closed his eyes. Relaxing tension turned clenched fists into hands; his moon-shaped face took on the full moon's sad calm. His mind was in the country of orbital mechanics now.

Thomas said, "If we just turn around I could have him home in just over four days. We're a day and a half out . . . another day and a half to decelerate, three more to get back to Falling Angel." Stonecypher tried to protest, and Janet laid a silencing finger against his lips. "If we make orbit and land the cable pod . . . call it seven days plus. It's faster coming home, without the mass of the cable pod." He licked his lips, and his breathing quickened as he juggled possibilities. "I can speed things up a little, too. Give me room—" He wedged himself past Dexter and the others to reach *Gabriel*'s control board.

"I'll start up the fission plant and give us more power in the ion motors. We're carrying more cesium fuel than we need, too, because it's a test run—" He was talking rapidly now, holding conversation with himself.

Janet watched him with pride, excitement, and an irritating grain of jealousy.

The radio cut in again. "It looks like if he doesn't die in four days, he won't die in eight either. Dexter, I hate to say it, but you either stabilize or you don't. And we sure as hell can't have you dying during re-entry. Did you give one second's thought to the *publicity* when you pulled this stunt?"

"That's not my department." Dexter laughed raggedly.

"Thomas, how are you doing?"

"Ask me again in a couple of hours, Fleming. This *is* a trial run. If everything works I can get us to Earth-orbit eight hours early. Back to Falling Angel in seven days one hour not counting the time it takes to land the cable pod and moor *Anansi* to *Gabriel*."

"I know you'll do your best. Dexter, if you wanted to be a martyr, couldn't you do it at home?"

A faint chuckle bubbled out of Stonecypher's throat. Then he began to cough, the racking sounds shaking him and cutting off his words.

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"All right. Marion, keep his heart and vital functions monitored. Dexter, you do nothing but rest for seven days. By then we'll have you in the best hospital in the solar system, the only one with pacemakers and free fall too."

***

The Earth was flowing beneath them now: fingerpaint clouds swirled in fluffy spirals on a blue-on-blue worldscape, sunglare blazing off the deep blue patch of the Mediterranean. Thomas, on duty at the command console, talked to himself out loud, keeping them posted:

"I've got the nuclear pile damped. Thrust dropping . . . turning the solar panels . . . got them edgewise now, going to batteries. Velocity seven point one two two KPS. Seven one zero zero and I'm cutting the cesium flow. Thrust is zero. We're in orbit. You're in charge."

"Good," Janet called from the flight deck. "Marion, make that call."

There was satisfaction in Marion's voice. "Oyama, this is *Anansi*. *Anansi* to Oyama. We are in orbit at seven one zero zero kilometers per second, altitude one one seven oh kilometers. We'll be deploying the cable pod immediately."

The voice that came back was dry and cultured, and relayed from the Sea of Japan by satellite. "Oyama Flagship One. We are tracking. Our present position is approximately two hundred miles southwest of Akita. Anticipate splashdown in two hours ten minutes, at eleven hundred sixteen hours, Tokyo time. Falling Angel has kept us well abreast of your progress. Most eager to receive package."

"You're aware that *Anansi* will *not* be going down?"

"We were informed. Please convey our sympathies to Dr. Stonecypher."

"Will do. We'll keep the line open."

A smile, the first warm one in days, was spreading across Janet's face. "Home stretch."

Thomas's head poked up through the ladder well. "How long do I have?"

"To suit up? Just as soon as I do this." One button on Marion's keyboard was surrounded by a tiny metal cage. He flipped it back and pressed. *Anansi* shuddered.

"What was *that?*"

Marion laughed. "I just cut us loose from the cable pod. It's the same key that blows away the main tank supports during a launch. That's why it's in that little cage. You don't want to jog it with your elbow."

He was tapping at the keyboard as he spoke, and *Anansi* continued to shudder. The cargo bay doors opened, quite evenly. Marion held attitude jet keys down, and the view through the windows swung smoothly: Earth, then stars, then the cable pod and ion drive, still linked, off to their right.

"I'll just bring us up close enough that we can use tethers," Marion said. "*Now* let's get dressed. Janet, take over?"

Thomas guided himself over to the lockers. He pulled his pressure suit out on its rack and backed in. There were zippers everywhere, and it took a limber man to get them all closed. Then it hugged him like a sausage skin. He pulled the fishbowl helmet over his head and clamped it down.

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Marion was still suiting up. De Camp waited until his partner's helmet was on, then switched on his microphone. "How you doing?"

"Fine." Marion turned to the airlock, using the magnets on his boots. He cycled through the airlock into the cargo bay. Thomas spared a glance at the sleeping Stonecypher. Have to keep him calm somehow, once he realized that they'd let him sleep through this. *It's going to be fine,* he said silently. *You'll see.*

He waited until the warning light turned green, then followed.

Marion was strapping himself into one of the chair-shaped mobility packs, and Thomas was right behind him. He checked the pack's circuits, then spared a glance up out of the bay. The Earth hung there, a dark swollen disk filling the sky.

In tandem, silently, the two men arced up and around until they cleared the wings.

The ion drive/cable pod combination hung close alongside. Everything looked fine. Thomas ran through his mental checklist. *Anything wrong? Ten limpet motors mounted in place, undisturbed. No obvious meteor pocks* . . . and what else *could* go wrong? The cable pod had been inert cargo till now.

Okay. Detach the mating rings. Separate the cable pod from the ion drive. Then back to the ship, check the cameras and other instruments, and send it on down.

The night-shrouded Earth formed a velvet-black backdrop. Here and there cities glowed; tiny sparks of lightning showed in a storm off Portugal.

"Ready?"

"Give me a moment," Marion said happily. "I never could resist a sunrise."

The sun flared into view; a sudden white crescent glowed along the Earth's eastern rim.

"Moving out," Thomas said. He jumped at the black Earth. His safety tether trailed back from him on loops.

"Thomas, did you see anything out there? I thought I caught a flare of some kind."

Let's get the job done, daydreamer.

"Where?"

"High in the atmosphere . . . Janet, did you see it?"

"No."

Thomas whistled low, in irritation. "All right, I'll take a look." He had almost reached the mating rings, where the ion drive joined the cable pod. Now his backpack jets flared and he veered away, behind *Gabriel.* "Okay, where?"

Marion sounded almost petulant. "It *was* there. I saw it."

Thomas closed his eyes and counted to five. "Right. Now can we get on with the—" The mating rings exploded, searing his vision white as the world turned to fire and pain.

7: Damage Report

His head snapped away reflexively, not quickly enough to miss it. Before Thomas's polarizer cut in, a terrifying image was burned into his retinae: light arcing, coiling around the cable pod like sentient lightning.

Something that felt like a wall of water smashed into his chest. The cable pod dropped below his line of sight, still

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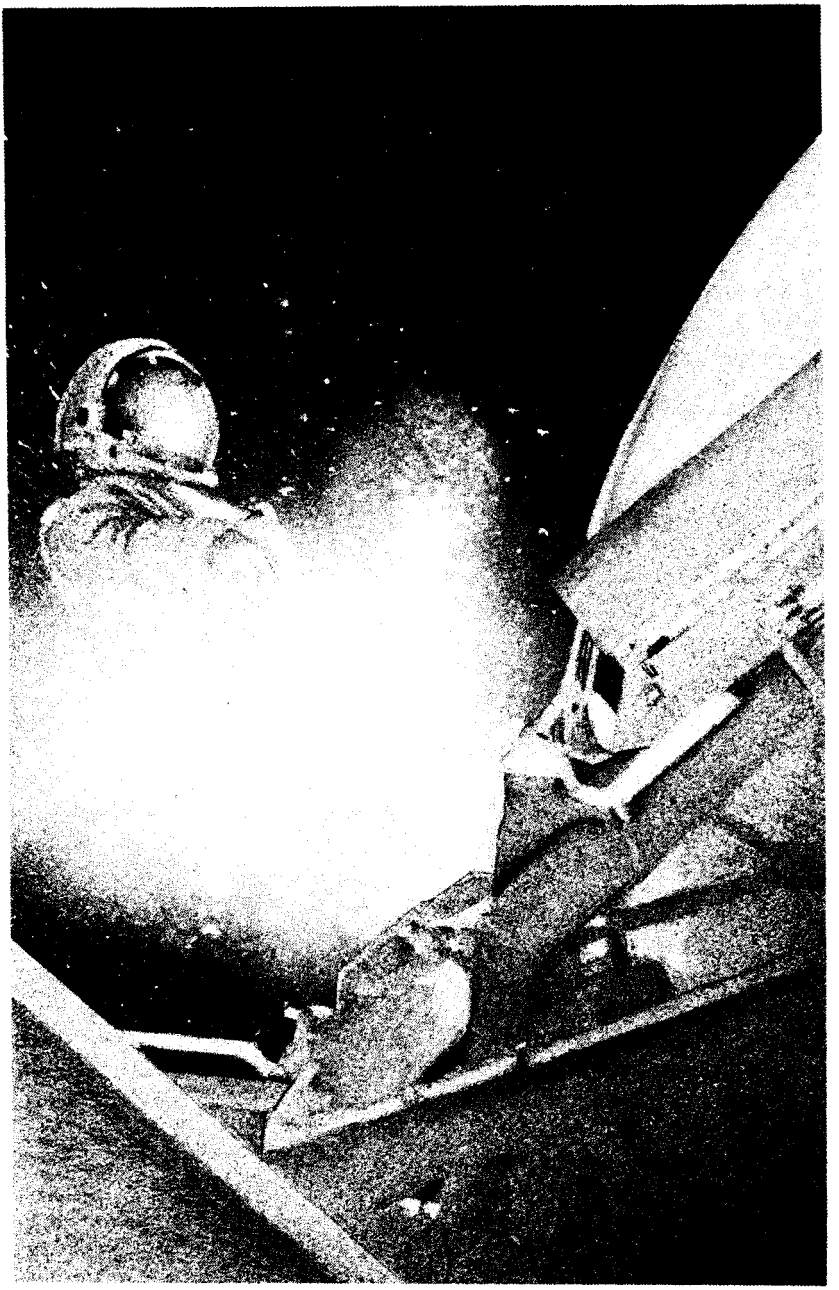

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spitting fire. Then *Anansi,* off to the side, seemed to explode in flame.

Hissing static filled his helmet, painfully loud. Space had turned foggy around him. *Anansi*'s outline, blurred and dimmed to dark blue by the visor, whirled past his field of vision.

I'm tumbling! His fingers tapped at controls on his chest, and hot gasses jetted from his mobility unit.

There was a spitting sound, and a stress-tautened voice rang through the static. "Tommy! This is *Anansi*." Janet's voice gained control even as he listened. *Good girl.* "Bad trouble here. Something gave us a hell of a wallop—" There was a string of words obscured by hissing, and *Anansi* passed his field of vision again. "I've lost some external sensors—don't think cabin integrity has been compromised—"

He'd killed the tumble.

Janet paused, then spoke again. "Tommy—relaying message from Marion."

There was a click, and Thomas could hear Guiness's breathing, heavy in his ear. "Thomas?"

"Here, Marion. About a hundred meters off *Anansi*. It looks pretty bad." The explosion had separated the cable pod from *Gabriel.* Re-entry shielding had peeled up around the tail of the cable pod, and a cloud of white mist surrounded the ion drive— "The ion drive's the worst. The solar panels are shredded, and I think the cesium tank must have been ripped open."

"Are *you* all right?"

De Camp gritted his teeth. "I'm all right—just shaken up and—" His ears popped. Horrified, he listened for a hissing sound—and heard it. "Damn." His voice went icy calm, freezing in an instant. "I think I have a leak here . . ." His visor had cleared and he checked himself over. The rip was two inches above his knee. It was small, and the edges were bubbling as the silicone self-seal frothed into action. "Minor—class one, maybe. Suit is sealing, but I'm going to put a patch on it." He took one of the flat, flexible repair patches from his side pouch and forced his fingers to obey, peeling off the protective backing and smoothing the patch into place.

"I have visual contact with you, Thomas. We're about equidistant from the cable pod, but I'm further astern. My suit-to-suit is out, that's why it took me a second to reroute through Janet. I think my mobility unit took a hit. Shrapnel, I guess . . . I'm tumbling. What the hell *happened?*"

The hissing sound had stopped. Thomas scanned *Anansi.* She was spinning around a skew axis. No obvious damage to the belly . . . none to the nose . . . she turned, and Thomas's heart sank at what had happened to the Shuttle's tail. The aft Reaction Control System pod on the left was ripped open and half melted. The fuel and oxydizer tanks must have ripped and exploded. That was the fireball. The vertical fin . . . blackened by fire.

Janet said, "I'm trying to stop *Anansi*'s spin, but I don't get anything from either of the aft RCS systems. Trying the forward module . . .ah." It looked like steam venting from *Anansi*'s nose. "I'm killing our spin."

The cable pod was worse hit. The fins were twisted, ruined; the heat-shielding had peeled upward in shards. What

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about the precious cable itself? He couldn't tell.

Fragments were still spinning in all directions, and everything still looked foggy with gasses and bits of metal. He finally picked out Marion's tiny form. He aimed himself toward Marion and used the mobility unit thrusters.

His course took him past the cable pod and *Gabriel*, slowly drifting apart. He was able to spot more damage. The mating rings were still mated, still part of the cable pod, but splayed and melted, as if they had been packed with Thermite. Most of the limpet motors had been blown into the sky; a couple still clung, in skewed positions.

He was running out of safety tether. Marion's must have been severed. The copilot was even now floating farther and farther from *Anansi*. Thomas hurriedly unhooked his own line before it could snap taut, and continued after him.

What in hell happened? He remembered Marion's words, ". . . a flare of some kind . . . high in the atmosphere . . ."

Janet's voice cut in. "I've lost my rear attitude jets. Have to use the front primary and vernier thrusters, but it's slow and—oh my God."

Her voice had gone from cold to frightened, and the sudden loss of clarity sent a knife point of anxiety into Thomas's gut. He could feel beads of sweat blossoming on his face. Ahead, within the metal-vapor mist, was Marion, turning helplessly.

"I just got a warning from Dexter's life support. His blood pressure's dropping. I think he's going into cardiogenic shock."

"His heart's giving out?"

"Yes, dammit, and I can't leave the controls. Get Marion in as soon as you can, he can see to Dexter while you check out the exterior damage."

Thomas gritted his teeth and adjusted his course slightly, preparing to move alongside Marion. The copilot was doll-sized now, a silver-white figure spinning slowly against a vast darkness. "Did you hear that, Marion?"

"God, yes. I'd like to think there's something I can do, but—I don't know. Everything's happening at once."

"Just hold on." Thomas snatched at Marion's hand as he spun past. He caught the back of Marion's wrist, then lost his grip. That left Thomas himself rotating. He used jets to kill the rotation and got back to Marion, who had shed some spin. Again Thomas caught his passing arm, held on against the recoil, felt Marion's hand close on his wrist. They jerked and spun. Thomas used the gas jets until they were both facing back toward *Anansi*.

"Man," Marion said as he righted himself. "Am I glad to see you."

Thomas hugged Marion from the back, to balance them, and headed back toward the crippled Shuttle. His eyes picked up the ruined aft section of the cable pod, and he snarled. They *needed* Dexter Stonecypher.

Marion heard the hiss of returning atmosphere in the lock, and his mind raced in a dozen directions at once. Damage . . . how much damage? And where? The cable pod was a ruin. It couldn't leave orbit . . . and most of the limpet motors were gone too.

The ion drive? Have to see, but with

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the cesium fuel tank ripped apart, *Gabriel* was surely unusable. *Anansi*? Both aft RCS pods damaged, and what else? The vertical fin? Could *Anansi* move at all?

We could be marooned.

The ready light blinked green, and he swung the inner door open. Thoughts of material problems disappeared as he saw Dexter, anchored by blanket and electronic sensors. The metallurgist was in pain, shuddering, gasping for breath, and although he faced the opening door his eyes didn't focus.

Marion doffed his helmet and pulled himself over to his patient. He checked the life support readout and swore. With desperate speed he danced his fingers over the controls. The diagnostic readout board cleared, then began to display. Marion said something foul.

Dexter groaned, eyes focussing at last on Marion. "Who's there . . . ?" he asked weakly.

The copilot watched the red and green graphics as the computer fed Stonecypher cardiotonic drugs, mechanically seeking to stave off irreversible shock. Dexter's voice, pitiable in its weakness, tore at him.

"Who's there?" The elder scientist's thin hand stretched out, grasping at air, and brushed Marion's shoulder.

"It's Marion, Doc." He wiped Stonecypher's forehead. "You're on board *Anansi*."

The older man's eyes focussed, and just for an instant he was there, really there in the Shuttle, a man who was weak, and pale, but lucid. "*Anansi*. What happened?" He grew more intense. "There was an explosion. Is the cable all right? Is . . . ?" He gasped for air, groaning as if his chest were bound tight with chain.

"Yes," Marion lied, remembering the blackened, ruptured cable pod. After all, the cable itself *might* be undamaged, though they wouldn't be sure until Thomas finished his report. "Everything's fine. You just relax."

"Yes . . ." His eyes drifted shut, even as his body shivered in pain.

The diagnostic display read, "80.00 poss ventricular tachycardia," and as the metallurgist's body relaxed with dreadful finality, Marion felt his sight blur. He fumbled for a tissue. Crying was a mistake in free fall; the tear built up into a single salty globule over the eye.

Stonecypher's body, anchored by its sensors and tubes and safety strap, remained upright after the display buzzed dully and flashed red, after there was no more movement. And no more pain.

"Falling Angel, this is *Anansi*." Janet was steady now, as steady as the ship herself. The attitude jets in the nose had finally slowed the spin, and Earth's disk no longer whirled crazily past their windows.

"We read you, *Anansi*. Request preliminary status report."

In cold, precise words Janet recited the litany of torn metal that screamed to her from the dials and cathode ray displays. She repeated what Thomas had seen on his preliminary inspection.

When she was finished she ran her fingers through her hair and calmed herself, feeling shakier than she cared to admit. There was the sound of cloth rustling against metal, and she heard Marion sigh. From the corner of her eye she

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saw the medical readout flashing red, and her head dropped.

Marion laid a slender hand on her shoulder. She saw his reflection, faint in the front window, as he shook his head in grim negation. He moved stiffly to his seat and immersed himself in the silent testimony of the readouts.

"Crew status," Janet said, her voice rough and too low. She cleared her throat, and the words became crisp and professional. "Crew status. Pilot De Camp and Copilot Guiness are unharmed. Ion Tech De Camp took a class one suit breach, was able to affect repair. He escorted Guiness to the lock, and is returning to the cable pod for full inspection. Metallurgist Stonecypher experienced terminal heart failure, apparently due to stress caused by the explosion."

The next voice on the line was Fleming himself, and he spoke with emotionless precision. "Can you describe the nature of the explosion?"

Marion leaned forward to the microphone. "I saw it, but I'm not sure I can describe it for you. There was a flash high in the atmosphere a few seconds before we were hit. Tentative hypothesis: missile attack of some sort. Never seen anything like that impact, though."

"Can you clarify?"

"The missile never came near us. It was a bright flash, but tens of kilometers below us. Maybe there was another missile, but . . ."

"Well?"

"No, dammit, it wasn't enough. A missile the size of the one we saw would have blown us all to gas. What *hurt* us was an explosion between the ion drive and the cable pod. It looked a little like napalm, or ball lightning. No . . ." He squeezed his eyes shut, trying to remember clearly. "The explosion seemed to *crawl* along the joining, spreading like the threads of a spiderweb. And it ripped up everything in its path. This was deliberate, and precise, and damned sophisticated. No missile could have done it. A mine. Maybe in the mating rings themselves."

8: The Good Neighbor Policy

Fleming sat, deadly silent, as the computer-animated *Anansi* went through her holographic paces. The damage to Shuttle and cargo pod was outlined in red: the ion drive was swathed in it.

Connors was there in the darkened room. Like De Camp, he was an ion drive technician and operator, though he claimed other skills too. He was a smallish beach ball of a man who kept to the low and null-grav sections of Falling Angel as much as possible. He was watching the cable pod burn.

Aerodynamics altered drastically, the grey oval began to glow soon after it reached the upper atmosphere. He watched as the foamed ceramic peeled off in blazing droplets, then chunks. The ruined fins had no hope of stabilizing its descent, and when the drogue chute finally popped free it was in tatters within seconds, a pitiful white streamer spattered with flaming ceramic and metal.

It impacted somewhere in the Pacific.

The lights came up in the room, and Fleming spoke quietly. "Thank you, Kelly. Join us, please."

"On my way."

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He swiveled in his chair, fingers steepled, peering over them at Connors. "Accurate?"

"Only too. There's no way in the world we're going to get that pod down without repair. And that's a chancy job. The patching material is going to change either mass or configuration." He thought for a moment. "We'll have to check the possibility of pushing Stonecypher's foam projector out to them. Any ideas?"

"One big one. *Susanoo* will be in in an hour, and that gives us an ion drive tug, *Michael*. You'll have to take *Michael* down to bring *Anansi* home. Any reason you can't push the foam factory down at the same time? I'll tell Strickland. I want a crew putting that package together quick."

The door shushed and Kelly was there, clothes thrown on roughly and hair unkempt.

He said, "Get me a line to Oyama, Kelly."

"There's something coming in on their frequency now, Doctor." She strode past him to her console, switched the transmission into the room.

Patches of light formed and congealed. The Japanese was a stranger, dressed in a dark, European-style business suit. "Mr. Fleming? I am Izumi, and I speak for Oyama Construction."

"Yes, Mr. Izumi. We are receiving you clearly."

"Good." But Izumi looked grim. "Approximately eight minutes ago, the following transmission was broadcast worldwide from one of the commercial satellites. The point of origin seems to have been Iran. Hold, please."

The air fuzzed for a few seconds; then a woman's face appeared. She was definitely Middle Eastern, and her hair was pulled severely back. The transmission seemed shaky.

"Taped under bad conditions," Conners muttered.

"Nations of the world!" Her English was thick and studied. "We, the United Moslim Activist Front, have struck a great blow for freedom. Today we have proven that there is nowhere on Earth—" here she paused for dramatic effect. "Nor in the sky where the cowardly lackeys of capitalism can hide from the wrath of the people.

"Today, using a surface-to-orbit missile of highly advanced capabilities, we attacked and destroyed the Space Shuttle *Anansi*. We grieve for the loss of lives. This tragedy was made necessary by the limitless greed of the capitalist nations, to warn them that they will not despoil the Earth and leave us a bitter husk. We will fight for our lands, and we will fight for our skies." She raised a khaki-clad arm, making a tight fist. "Long live the revolution!"

She faded from the screen.

"A Prometheus?" Connors asked incredulously.

"More likely the Soviet version." Fleming fell silent.

The air fogged again, and Retsudo Oyama appeared. He seemed grimly alert, though there was a pink puffiness to his eyes . . . what was it, five in the morning down there? He said, "I hardly need to tell you of my concern, Mr. Fleming. I need to know: How accurate are the claims of the UMAF?"

"There has been damage to *Anansi*, but she hasn't been destroyed. We . . . lost one of the crew. Dr.

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Stonecypher, the mind responsible for the cable."

Retsudo's forehead furrowed. "I am very sorry. He was a great man. I hope—" he paused, trying to phrase his words delicately. "I hope his final work was not destroyed."

"Preliminary reports indicate that the cable pod was damaged. One of the crew, Thomas De Camp, is investigating more closely now. We hope to have a favorable report within the hour."

The younger Oyama's head bobbed fractionally. "As to the nature of the attack . . ."

"Yes?"

"As an industrial nation dependent upon foreign resources for our raw materials, Japan has suffered its share of terrorism. We have had brushes with the UMAF before. Never have they displayed the technical skill necessary to accomplish this feat. Although they have used sophisticated explosive devices in the past, I am suggesting that a sudden leap into the space age must be viewed with suspicion."

"We . . . are viewing it with suspicion, yes." Kelly recognized Fleming's expression. *Should I tell Oyama about Guiness's suspicions?* He changed the subject. "Under the circumstances, it would seem impossible to meet our deadline, although I think I can guarantee safe delivery of the cable. I hope that this problem will not escalate beyond negotiability?"

"As I said before, Mr. Fleming, we understand terrorists. There are two things to remember in dealing with them. First: we must *never* accede to their demands. Second: those of us who abhor their actions must be prepared to stand together against them. I know that I speak for my father when I say that Oyama Construction will be willing to make reasonable trade for time and money lost."

"Thank you," Fleming said, desperately wishing he could reach out and shake this man's hand. *He understands, by God!* "Thank you so very much, Retsudo. Unless there is something else, we have work to do."

There was nothing else, and the Japanese signed off, his image evaporating in snow. Fleming's mouth set in a grim line.

Kelly broke a chilly silence. "Doctor, if it *was* a bomb . . . a mine . . . then surely whoever set it would have left with the rest of the Earthbound?"

Fleming didn't look up. "Yes. We might hope so. There's no way to be sure, not until we check out everyone who had access to *Anansi* during its drydock. Unfortunately, that could be almost anyone."

Thomas nudged the left toggle on his mobility pack, and came in for a closer look at the cable package. The tail was half in black shadow, half in blazing sunlight. The outer shell of foamed lunar stone, man-made pumice, had cracked and splintered, isolating the twisted fins and their attached motors. Thomas caught glimpses of the inner envelope in curves of blackened steel.

"Thomas?"

"I'm moving in now. Contact in about ten seconds."

"We have you, Thomas. How's the leg?"

"The seal is fine. Hurts, though. I

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think there's shrapnel buried in there. As long as it hurts I'm not worried. If it starts getting numb I'm coming straight back in."

He hovered a few centimeters from the pod and shone a hand-light into the wound. "Ripped right down to the inner package, but . . ." For the first time in a hour, a grin broke across his face. "I'll be damned if it doesn't look secure."

"Thank goodness. I—" Marion broke off. When he came back on, all the pleasure in his voice had been leached out. "Thomas, I'm picking up something on radar. Two blips, rising through the atmosphere above South America, ahead of us. Hold on, I'm getting Janet up here." Another pause, while Thomas pivoted his mobility pack, found South America and searched the clouds. "Do you have visual contact?"

He drifted away from the cable pod. He strained his eyes, the pain in his leg becoming a thundering heartbeat. "I see something. Two dots."

Janet was back on the line. "I'm here, Tommy. There's two of them. They seem to be matching course with us. What can you see?"

At last he could make something out. Two points of light became finned wedges— "*Not* missiles. We've got shuttles here, people."

Marion laughed nervously. "The cavalry arrives."

Janet cut in, totally unamused. "Wait a minute. Who in the world had time to put together a rescue mission? Open hailing frequencies, Marion. Let's see just what we have here."

"This is the Space Shuttle *Anansi* calling unidentified shuttles. Please acknowledge." Marion sat back in his seat and watched the speaker. No answer.

Janet watched the radar image on the cathode ray display, wishing that they had visual contact. "Well, there are any number of possible reasons. Set our receiver to search the bands—they might be using an odd frequency."

He nodded, complying. "About three kilometers now—"

The speaker came to life with a crackle of sound. The voice it carried was American. "*Anansi*. This is the Shuttle *Brasilia*. Do you copy? Over."

"We copy, *Brasilia*. What's your business?"

The man on the other end laughed easily. "We're playing good neighbor. Heard about your trouble and came running."

Marion started to speak, but Janet raised a finger of warning and switched on her own headset. "This is Captain De Camp of *Anansi*. You people are very efficient—I assume that you put the mission together from scratch in . . . say, three hours?" It was difficult to keep the sarcasm from her voice, but she thought she'd managed it.

Maybe not. The American laughed less easily this time. "Not from scratch. We were preparing for test runs in just under twenty-four hours."

Marion shook his head, made a thumbs-down sign. Janet snorted silently, but said, "I'll buy that. Who am I speaking to? And why are there two shuttles? One's enough to tote us down."

Brasilia was silent for about fifteen seconds. Marion said, "They're about

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two kilometers away now. One of them is slowing to a crawl."

"This is Captain Burgess speaking. We were set for a double launch when the news came in. The other ship is *Willy Ley*. Nobody aboard speaks English."

"Who sponsored the launch?"

There was another pause. "The Brazilian government owns both shuttles."

Marion said it, softly: "That's not an answer."

Janet asked, "Why weren't we notified that you were coming?"

"We tried to reach you, couldn't get an answer. We assumed that your radio was damaged. Is that the case?"

"That is . . . possible. All right, *Brasilia,* what's your plan?"

"Depends on your situation. Can you re-enter?"

She couldn't avoid a question so simple and so urgent. "No. We can't move. Both of the aft Reaction Control System pods are torn to hell."

"Well, as soon as it can be arranged, we'd like to take you aboard."

"And our cargo?"

Another pause. "We may be able to move your baggage into *Brasilia's* cargo bay." Burgess's tones were soothing.

Janet sat back from the board, frowning. "We'll have to think it over."

"Don't take too long. After all, you can't re-enter, and you can't return to Falling Angel. We're just trying to help."

"I said—we'll think about it." She turned the radio off. She said, "Salvage."

"Maybe."

"Burgess. Ever hear of him?"

Marion watched the radar blips creeping toward them. "The name rings a bell, but I can't be sure. NASA, I think."

"And renting out to Brazil now?"

"You know something? That stinks." One of the dots had stopped, hovering near the cable pod. The other drifted toward *Anansi*. "The runner-up in the cable bidding was Brazilian. I think we'd better assume that our Captain Burgess is in the employ of Brazil Tecimetal-Electromotores. They want the cable."

Janet popped open a squeeze bottle of water and took a swallow's worth. She squinted at the radar screen. "Tommy." She opened the ship-to-suit band.

Marion said, "Be careful. They'll pick up our transmission."

"Tommy? This is *Anansi*. How is everything out there?"

Pause, then a hiss of radio contact. "Just fine. What's the word?"

"Well, it looks like we're out of the woods. All we have to do is hitch a ride and go home." *Please, Tommy—*

"That sounds pretty good. I'm getting lonely out here. We'll want to make a pretty thorough damage report before we leave, and we'll have to check out procedure with Falling Angel. Could take a few hours, though, so we'd better get on with it. Oh, by the way—" his voice took on a deceptively casual tone. "The ship here with me is *Brasilia*. The one heading toward you is *Willy Ley*. Didn't the Brazilian government buy that one about five years ago?"

"Go to the front of your class. Our friends are from Brazil."

"Well . . . as long as they don't want to play *piñata* with *Anansi* I guess

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we'll be all right. I think I'll stay here and check the cable pod awhile longer, if you don't mind."

Janet pressed her mike a little closer to her mouth, smiling. "You hang on out there. There's an answer to this."

"Let's define the questions first. Call me when you have something." And he clicked off.

Janet resisted the image of Thomas, tiny against the hulk of the cable pod, sandwiched between it and the Shuttle *Brasilia*. So vulnerable . . .

On the radar screen, *Willy Ley* had nearly drawn abreast of *Anansi*. "They only need one to take us down," Marion said. "The other must be for the cable. They can moor to the cable and claim salvage."

The black underbelly of *Willy Ley* was pulling into their field of vision. Janet watched it speculatively. "They killed Dexter. One ship . . . only one ship is doing all the talking. The other one is hanging over our heads, ready for action if things go wrong. 'Jane' back there—" she jerked an impatient thumb in the direction of the cable pod and *Brasilia*— "is going to be all sweetness and light until they realize how much we've figured out."

"Then 'Tarzan' swings in and takes the bananas."

Janet laughed suddenly. "Burgess is cute." She caught Marion staring and said, "Not cute that way. I meant that offer to take what's in the cargo bay down for us. It's all stuff for handling the cable. So the tools go down to Brazil, while *Willy Ley* claims the cable. Then BTE offers to buy the tools too."

"Cute," Marion said without a smile. *Willy Ley* had halted, hanging suspended above them, a silent reminder of their helplessness. "We've got to get out of here. There's no way in the world that we can let them get away with this kind of piracy."

"We can't go anywhere. No rocket motors." Janet pounded her fists against the console, hard, once only. "Never mind. If there's a way, I'll find it. We'll find it."

9: Drawing the Line

"Tommy. Do you read me?" The sound fought its way through a cloud of pain, a rhythmic pulsing that swirled up Thomas's leg and into his chest. He jumped. Must have dozed off. . . . In panic, he checked his air gauges. No problem. It was just too warm, too quiet and, with his faceplate fully polarized, too dark.

He looked up, saw *Willy Ley* blotting out the stars like a great dark scavenger, its belly armored with heat-shield scales. "I'm here." He rotated his suit to face *Anansi*. She seemed close enough to reach out and touch, a toy floating at arm's length. "I'd really like to come home."

"How's the leg?"

"It still hurts, so it's okay, I guess."

Janet sounded relieved. "Good. Listen. We're thinking about the ride home we've been offered—"

No! "Janet, listen—"

She interrupted him urgently. "No, Thomas, *you* listen. We have to remember what Dr. Anansi always said: 'You have to know where to draw the line.' "

Dr. Anansi? What the hell was she talking about?

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"So check over the pod once more, then come on back. No arguments—I hope I don't have to make myself any clearer."

Thomas thought furiously. She was afraid the bandits might eavesdrop. Reasonable. So: *Dr. Anansi*. Doctor Shuttle? Doctor Spider? The Shuttle was named for an archetypal spider, a nasty character from African legend who had crept into Heaven and been evicted. *Draw the line?* It hit him suddenly, and he grinned into his microphone. "I'll be heading back in a few minutes. I've only got a little *moor* to do out here."

He hoped she'd caught it.

"Fine, Tommy. We'll be waiting to hear from you."

Thomas sipped from the nipple at his cheek and washed his mouth out hard before swallowing. It wasn't cold, but it helped him feel awake and alive. He detached his safety line and crawled back along the gently curved surface of the cable pod.

It was clear enough what she wanted . . . and that wasn't going to be easy. But for what?

There were steel handholds and foot rests placed for the benefit of those who had built the cable pod. Thomas was glad for that. Early astronauts had half killed themselves trying to work in free fall with nothing to brace themselves.

Anansi = spider. Doctor = Dexter Stonecypher. Draw the line—

Thomas paused, gripping one of the metal hand rungs. *They killed Dexter!* The thought echoed within his skull, a mix of grief and incredulity and rage, shockingly strong.

Access to the cable was at the back of the pod, between the fins. Heat from the explosion had remelted some of the lunar slag, and Thomas's fears were justified: the access plug, a steel screw-hatch set in the cannister and now showing through the ripped foam shell, was warped.

He gripped the wheel-shaped handle and turned as powerfully as he could, straining until it felt like his shoulders were coming apart. He felt his fingers biting into the glove padding, felt his leg wound start to burn. The wheel didn't budge.

Thomas detached the cable gripper from his belt. It was a great clumsy plier-like thing with blades and pressure points of tungsten carbide, designed solely for gripping or cutting Stonecypher's cable. The enormous gear ratios and the small motors inside it made it a massive object indeed.

It made a dandy hammer. He braced himself and pounded the wheel a few times, rim and center. *Break up the vacuum cementing*. He tried the wheel again. It didn't move.

He flipped on his radio. "Janet. There's something here that needs to be secured, or vice versa, but my air will be running low in about fifteen minutes. I may have to leave it."

"Your choice."

Thomas detached the cutting torch from his belt. He braced himself anew, for fear of being jarred loose. In free fall and vacuum, the torch would act as a rocket.

He worked the torch in a circle around the screw, holding it a fair distance from the metal. He wasn't trying to cut anything, yet. He only wanted to heat the surface as evenly as possible, to expand the metal.

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Without atmosphere, there is no convection to help get rid of waste heat. But there *is* conduction, and Thomas, enveloped in gas that was vacuum-thin but flame-hot, was swimming in sweat within a few minutes. Combined with the throbbing in his leg it became almost too much to tolerate. *You can't make it in time*, an insidious voice whispered.

His oxygen was low; the power in his batteries was dropping. He had to try *now*. Another five minutes and he wouldn't have the safety margin he'd need to return to the ship. He clicked off the torch and reached for the wheel.

It was unpleasantly hot, and he knew that without his gloves the flesh of his hands would have been seared to the bone. Again, he set his feet, inhaled deeply, and threw his body into the effort. There was an inch of give, then it stuck again. This time he didn't give up.

It moved. Sluggishly, as if the screw didn't quite fit the grooves any more, but it moved; and the ion tech grinned in savage satisfaction.

He unwound a foot and a half of steel screw before it finally came free. The first two meters of cable were sheathed in yellow plastic a quarter of an inch thick, but after that it seemed to disappear. He cautiously grasped the plastic section and pulled it out into unfiltered sunlight. It unreeled easily.

Beyond the plastic was naked cable, the precious end product of seven years of work and hope. Almost as thin as spider silk, it was a dim hairline that barely reflected the light at all.

The yellow plastic was wound around a hook on the underside of the screw and he undid it, sliding out the thin metal bar where the plastic terminated. He tied the bar to his safety line.

He triggered the backpack jets. They took him up and out, and the cable line tautened behind him. Drag slowed him almost to a halt. But the cable was running free, unwinding, spinning out behind him like a single strand of spider silk. He fired the jets again. *Anansi* wasn't far: a quarter of a mile, no more. If the drag cost him his backpack fuel, the cutting torch would still serve as a rocket.

Thomas loved open spaces. He had traded the vast plains and rugged mountains of his youth in Southern Alaska for a greater vastness. But now, crossing on invisible thread between the cable pod and his own ruined spacecraft, with bandit ships ahead and behind . . . he felt utterly vulnerable. *Can't fight, can't run. Has Janet got something in mind? Or is she just thrashing around?*

The doors of the shuttle bay were wide with welcome. A pressure-suited shape waved him down. Thomas detached the yellow leader from his safety line and moored it to a supporting rib on the inside of the bay.

"Bombs," Thomas said. "Time or radio-controlled. If they put one in the locking ring, maybe—"

"I searched." Marion shook his head. "Can't find anything that shouldn't be there, but there's no way to search everything. You want to open every package in the cargo bay?"

"No."

Janet spoke in their helmets. "Marion, are you ready to go for the limpet motors? We've got to have them."

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"I'll go right after I refuel the mobility unit."

"What's the chances of their spotting you?"

Marion grinned. "Oh, they will, but they're not likely to guess what I'm doing."

Air hissed into the airlock. Thomas unscrewed his helmet and ran the back of a gloved hand over his face. He was sweat-sticky and knew that his dark eyes were puffy.

The inner lock opened. Janet was in the lower deck, scribbling on paper stretched up against the lockers. Thomas said, "Hi. Why do we need limpet motors?"

"In a minute, Tommy." She turned from her paperwork. "Let's look at your leg."

Thomas was exhausted on every level his senses could touch, but still felt himself tense when Janet began helping him out of his suit. "I can do it, dammit—" he started to say, and only then realized how his voice and body were trembling.

"Don't, Tommy. Don't push me away now, please? You need help. Don't make me pull rank on you."

Somehow, that made him smile. He stumbled back out of his suit, limbs feeling clumsy and swollen.

There was blood darkening the synthetic material of his overalls, partially clotted now, and he didn't resist as Janet helped him to a web. He curled his fingers around its strands and closed his eyes. He heard her busy herself at the first aid cabinet, felt her as she snipped away the material to expose the wound.

"Tommy . . . you should have let Marion do the inspection. This should have gotten attention hours ago."

He felt too weak to argue, and didn't. Her hands were cool and soothing as they manipulated his leg, gently wiped away the thickened blood. "There's something in there, all right. This is going to hurt a little." He flinched as the knifepoint of pain lanced into the muscle over his knee. Thomas heard his wife's words of encouragement as if they were whispered far away.

"There," she said, and he opened his eyes. She stood, holding a shard of grayish shrapnel between the tips of her surgical tweezers. "Foamed ceramic. Part of the cable pod."

She dressed his wound, and held his hand as he flexed the leg experimentally. "I think it will work," he said, wincing. "Thank you." Their eyes met, and he knew that some of the accumulated resistance was gone, that a direct current of understanding passed between them. His mouth grew cottony, and he swallowed hard. "I'm tired, Janet, but I can keep going. Now. Why did you want the cable? And why the limpet motors?"

"I've got an idea." She waved at the expanse of scribble-covered paper. "Look it over. Tell me if I'm crazy."

Glad that there was no gravity to test his knee, Thomas crossed to stare at her diagrams.

She had sketched a shuttle outline, recognizably *Anansi*. A line ran straight up from the shuttle's open cargo doors. An arc of Earth's surface was below. The line reached up to a rocklike shape with fins. In the middle of the line were the words "Approx 2 km?". Off to the side were two *Anansi*-shaped craft emblazoned with skull and crossbones.

"I'll be damned. Tides," he said.

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Janet spoke from behind him. In her voice was a touch of belligerence, and a bit of a stammer too. "After all, we want *Anansi* to go *down*, right? And the cable should go *up*, out of their reach. Well?"

"You're not much of an artist," he said, images flowing together in his mind like colors in a paint-by-numbers drawing. "But you don't have to be. You're one hell of a smart lady."

"Will it work? *Anansi* can stand a re-entry, right? The heat shielding is almost intact. Maybe some of the tail would burn away, but—"

He waved it away. "That's your department. If you think we can re-enter, fine. Getting down is the problem. We don't have any rockets, barring the nose jets and . . . even one limpet motor would do it, this way, except that it'd take longer."

"Okay. And the bandits are the original shuttles. That design was proxmired in the seventies. Congress tried to build it cheap, and it doesn't carry enough fuel to get very high. If we can put the cable in a higher orbit, it'll be out of their reach. They'd have to launch a shuttle with an auxiliary tank. Falling Angel will have an ion tug here before they could launch. I think we can beat them," she said, moving up close behind him. She seemed a little breathless.

"The cable can take the stress if *Anansi* can."

"*Anansi* and the cable and Dexter's special staples and glue. It *all* has to hold. Mmm . . ."

Enveloping the squat outline of the shuttle were wavy lines representing atmosphere, above the curve of the Earth's surface. In Thomas's mind, stress vectors performed a war dance, and he burned to get to his computer. "Nobody's ever tried anything like this," he said slowly, "except for some early gravity-stabilized camera satellites. The satellites would reel wires out in opposite directions, and tidal effect held the wires oriented on a line through the Earth. They don't do that any more."

"Why not?"

"There are better ways to stabilize a satellite. Never mind. We have all the information in the world on the cable, the structural strength of *Anansi*, tidal stress, winds . . ." his voice trailed off. "I'll have to try to program a model of this."

"Marion and I tried it, but you'd better check us out."

"I'll do my own." The excitement was building up inside him, its brightness pushing aside the waves of uncertainty and fatigue, and he knew, even before he checked it with the computer, that Janet had found a way out. ■

The complete book, The Descent of *Anansi, will be published in October by TOR Books.*

● The world will always be governed by self-interest: we should not try and stop this—we should try and make the self-interest of cads a little more coincident with that of decent people.

Samuel Butler

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Jay Kay Klein's biolog

George W. Harper spent a number of years as a Futurist-in-hiding, bastioned behind pen names except in the pages of *Analog*, since his predictions were too often too grim and scientifically or politically unacceptable to the Establishment of the day. He joined the centuries-old speculation on Mars in a first article for the May 1963 *Analog* with "Observational Difficulties," which so impressed editor John Campbell that he accorded it a place of honor as the lead-off item, directly behind the editorial. Two years before the first fly-by, George explained "canals" as an optical artifact created by immense numbers of asteroid craterings, along with scattered volcanoes. When the first orbiter reached Mars, sure enough, there was one of the vast dust storms envisioned by George. Many weeks later, the tops of huge volcanoes poked through storm openings, followed by sightings of myriad astroblemes.

A particularly offensive prediction, made by George in a local Chicago paper in 1949, was that Americans routinely would elect movie and TV performers to political office. In 1953 he really struck a nerve with the statement that American colleges would see massive violence. The country in those days simply was not up to facing arson, riots, and assassinations in its future.

That's when George moved to Alaska to backpack for a couple of years in the bush. He was used to sudden changes of habitat, having attended 43 different grade and high schools as his parents moved from city to city at intervals of a month or two (they were in the City Directory business. One year saw him in eleven schools). The University of Chicago followed, interrupted by WWII, and later University of Chicago again before Bradley University, where classmate Phil Farmer threw a memorable party upon selling his first hardcover novel.

George's own first science fiction story sold in 1948. He decided then to be a full-time writer, though like many a similarly determined person wound up with an assortment of jobs in the meantime: instructor at three colleges, director of a small observatory, and inventor of a wind turbine system. With an educational background divided between the humanities (philosophy and history) and science (astronomy and astrophysics), he was able to link historical trends, current events, and the effects of technology into likely patterns of future development. Unfortunately, the predictions were not pleasant; and considering those that have been uncannily correct, one could wish that Mars had *not* been cratered, that riots had *not* taken place on campuses, and that movie stars had *not* been elected to high offices. That way, one could happily discount the further unpleasantnesses George has predicted. Included are gloomy prospects for energy resources and development of fascism in the United States.

His most recent book came out early this year: *Gypsy Earth*, Doubleday. Nearing completion is a book on the origins of the solar system, to incorporate articles appearing in *Analog*, including this issue's piece. ■

George W. Harper

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THE INNER FIVE

The origin of the moon is one of the classic puzzles of astronomy. Maybe it went something like this...

George W. Harper

Some problems never quite seem to get solved. Just about the time we think we have a handle on them something snaps and we wind up back on square one. Astronomy is particularly prone to this sort of thing, and we can point to any number of cases where two or even three centuries of study have failed to lead to a firm conclusion.

A case in point is the nagging little problem of the origins of our moon. Was it physically expelled from Earth, as some have claimed? Was it captured by Earth as an essentially complete

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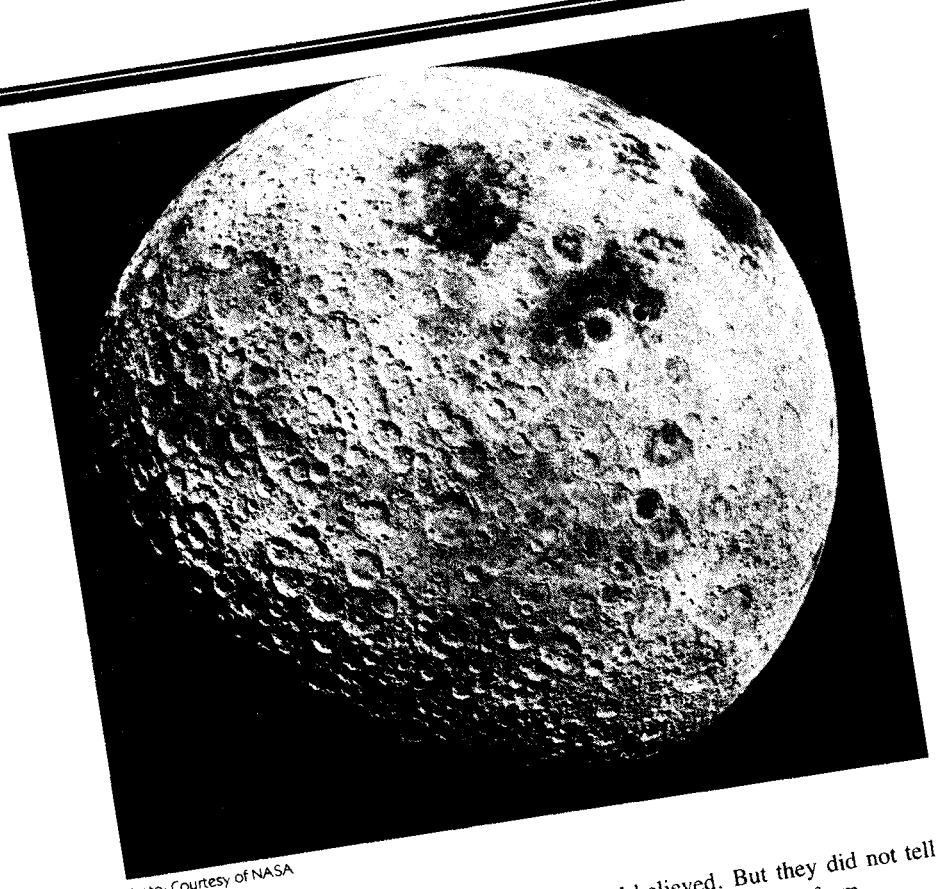

Photo: Courtesy of NASA

body, as others suggest? Or was it formed more or less *in situ* as an aboriginal companion of Earth, as a third group argues?

When we landed our astronauts on the moon, a number of physicists harbored a quiet hope the discoveries made there would somehow lead to a final resolution of the question, but luck was not with us. The samples of lunar rock proved fascinating and informative. They eliminated a few long-cherished ideas. They told us dozens of things we never knew before and confirmed a few things we had believed. But they did not tell us where the moon came from.

Now all this may seem a distinctly minor problem. The whole art of astronomy is liberally sprinkled with questions and difficulties. No matter where we peer into the heavens we find them . . . and alongside such weighty matters as the origins of galaxies and the fate of the universe, the question of the parentage of a single satellite of a relatively minor planet must seem remarkably trivial. Why bother with so

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TABLE I

PLANET & SATELLITE	Distance from Planet (10^3km)	ORBIT Inclination[§]	Eccentricity	Radius (km)	Density (gm/cm^3)
EARTH					
Moon	384.4	18-29°	0.0549	1738	3.34
MARS					
1) Phobos	9.4	1.1°	0.021	12	?
2) Deimos	23.5	1.6°	0.003	7	?
JUPITER					
1) Io	421.8	0.03°	0.000	1750	3.5
2) Europa	671.4	0.5	0.000	1820	3.07
3) Ganymede	1 071.	0.2	0.002	2610	1.93
4) Callisto	1 884.	0.3	0.008	2450	1.65
5) Amalthea	181.	0.4	0.003	75	?
6) Himalia	11 500.	28.	0.158	40	?
7) Elara	11 750.	26.	0.206	26	?
8) Pasiphae	23 500.	146.	0.38	18	?
9) Sinope	23 700.	155.	0.27	21	?
10) Lysithea	11 800.	28.5	0.135	20	?
11) Carme	22 500.	163.	0.207	22	?
12) Ananke	21 200.	147.	0.169	18	?
13) Leda	11 090.	27.	0.148	6	?
SATURN					
1) Mimas	185.7	1.5	0.0196	225	0.5?
2) Enceladus	238.2	0.02	0.0045	290	0.75
3) Tethys	294.8	1.1	0.0000	510	1.2?
4) Dione	377.7	0.02	0.0021	420	3.6?
5) Rhea	527.5	0.3	0.0009	650	1.5?
6) Titan	1 223.	0.3	0.0289	2570	2.42
7) Hyperion	1 484.	0.6	0.104	210	1.56
8) Iapetus	3 563.	14.7	0.0285	575	2.21
9) Phoebe	12 950.	150.	0.163	130	?
10) Janus(?)	168.7	0.0	0.001?	90	?
URANUS					
1) Ariel	191.8	0.0	0.0028	750	?
2) Umbriel	267.3	0.0	0.0035	490	?
3) Titania	438.7	0.0	0.0024	880	?
4) Oberon	586.6	0.0	0.0007	800	?
5) Miranda	129.35	0.0	0.000?	275	?
NEPTUNE					
1) Triton	353.6	159.9	0.000	2250	4.9?
2) Nereid	5 570.	27.5	0.7493	265	?

[§]All inclinations have been adjusted to the plane of the planetary equators. Our moon, for instance, is ordinarily shown inclined 5.1° from the plane of the ecliptic—the Sun-Earth orbital plane—but this can prove misleading whenever we attempt to contrast the lunar orbital elements with those of other satellites. We have also calculated all inclinations from direct motion. A satellite moving backward (retrograde) in its orbit is presumed to be inclined beyond the 90° point. This is a fiction, but a useful one here.

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petty a question when there are so many bigger ones to fret over?

The trouble is, the question is not as trivial as it seems at first glance; and the further we dig into the matter the greater the complexity we find. Ultimately it proves a singularly frustrating topic, made all the more so because the moon is literally sitting on our doorstep as if daring us to solve its mysteries.

In keeping with the apparent triviality of the question, the raw data we have to work with is deceptively simple. A single column suffices. We have a satellite in orbit about Earth at mean distance of 384,405 km, with an orbital inclination to the ecliptic of 5.1° and an inclination to the Earth's equator of 28.55°. Orbital eccentricity about Earth is 0.0549. The lunar radius is 1738 km and its surface gravity amounts to an acceleration of 162 cm/sec^2, from which we derive a mean density of 3.34.

All this is scarcely the stuff of mystery. Certainly it does not look to be the sort of material capable of generating more than a century of argument and doubt among astronomers. As a matter of fact, the problem arises not from the specific data itself but from what happens when we start contrasting it with similar types of information obtained from other bodies in the solar system . . . and then it becomes a headache.

Setting the stage, we begin with the simplest item and go from there. Table I lists 33 satellites for which more or less complete orbital elements are known. Recent discoveries by the Voyager probes have given us several new satellites to play with and it is likely a dozen or more remain to be discovered around Uranus and Neptune, but these 33 should be representative enough for our purposes.

Generally, these satellites fall into two distinct categories: an inner group possessing an appreciable size, small orbital inclinations, and small eccentricities, and an outer group which is much smaller in average size and possessed of high eccentricities and inclinations. Falling into category I are both moons of Mars, 1 through 5 of Jupiter, 1 through 6 plus #10 of Saturn,* and all five of Uranus. In category II we include 6 through 13 of Jupiter, 8 and 9 of Saturn, and 2 of Neptune.

This leaves us with three satellites which appear anomalous; our moon, #7 (Hyperion) of Saturn, and #1 (Triton) of Neptune. So far as Hyperion is concerned, its fairly close proximity to the relatively massive Titan leads to a medium-complex four-body problem involving Titan, Saturn, and the Sun. Between them we can account for its high eccentricity quite nicely and so need have no qualms in reassigning Hyperion to category I status.

The moon and Triton are altogether different matters. Both are massive, ranking among the largest satellites in the entire solar system. By this token we would expect to find them falling into category I. On the other hand, while boasting an approximately zero eccen-

**NOTE: Since this writing the very existence of Janus has been called into question. Precisely what was seen is doubtful, but something did show up on several photos taken at the time of the purported discovery. We continue to include it for the sake of completeness, however.*

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tricity, Triton's orbit is inclined nearly 160° . . . or 20° but moving retrograde if you prefer the more orthodox way of describing it. Either way it is difficult to include this category I.

The case of the moon is less obvious. While its eccentricity is several times larger than the average for category I, it is less than half the mean for category II. On the other hand, its inclination of 28.55° puts it right in there with the other category II objects. So now we have two moons with sizes and masses typical of category I but orbital features common to category II. To which category should we assign them?

It is tempting to call this a supremely unimportant question. Throw them into one or another category and move on to something more useful . . . right?

There's the rub. Current thinking believes category I satellites are aboriginal with the formation of the parent planets. Somehow, in the process of accretion or condensation, portions of the material which normally would have gone into the makeup of the planet were left behind to take up independent existence as moons. A critical signature of all such objects would be an equatorial orbit of low eccentricity. A second element would be a fairly large size by contrast with non-aboriginal satellites.

Category II objects are generally believed to be captured bodies—cometary nuclei, smallish asteroids, and the like—somehow acquired over the eons. Given the correctness of this belief, then if the moon is to be assigned category II status it must be presumed to have been at one time a free-orbiting planet, possibly in roughly the same orbit as Earth, acquired by us sometime in the remote past.

Although no one has ever taken a poll on the question, I would suspect a majority of all astronomers who have given the matter any thought subscribe to this view of the moon as a special acquisition, picked up by Earth several billions of years ago.*

Unfortunately, none of this really disposes of the question. We have arrived at an awful lot of conclusion from some very thin premises. We believe category II satellites are captures and we have some not very firm evidence suggesting the moon is a category II satellite; ergo the moon is a capture. But none of this is proof, or even an approximation to proof. At best it is merely a line of speculation . . . and remarkably shaky speculation, at that. To illustrate, suppose we look more deeply at the assumption the moon belongs in category II.

We have already remarked that both Triton and the moon are unexpectedly massive objects for category II. The largest of Jupiter's category II satellites is only around 40 km in radius. Number 8 of Saturn, Iapetus, has a respectable radius of around 575 km, but this is still less than a third that of the moon and

Preempting possible over-exuberance about the time frame involved, we can pretty definitely establish that if the moon was acquired in this way it cannot *have been more recently than some three billion years ago at the latest, so any effort to employ a lunar capture as a means of accounting for the extinction of the dinosaurs or the onset of ice ages can be ruled out. If the Earth captured the moon it did so quite early in the history of the solar system. This much is certain.*

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about a quarter that of Triton. Additionally, with its inclination and eccentricity proving to be only about half that of the moon, it is possible Iapetus ought to be classified as another anomalous body rather than a true category II object. In short, pending some resolution of the matter on other grounds, there exists a clear possibility that any assignment of the moon to either category I or category II is premature. This puts us back on square one. All we have done is establish the character of the problem; we have not solved it.

Then there is another problem. It is easy to speak glibly of "capturing" satellites. It is much more difficult actually to manage it. In a two-body model there is only one possible way for a satellite to be captured, and it is so remote as to be next to impossible. To illustrate, imagine a small asteroid falling toward a planetary mass. As it falls it acquires speed. Ultimately it either strikes the planet or it misses it. If it strikes it ceases to be a problem, so all that concerns us is what happens when it misses.

In the absence of friction to bleed off momentum, it turns out that the speed required to escape the planet altogether equals the speed acquired in its fall toward the planet. Given this, our asteroid simply climbs out of the gravity sink and continues on its way. The *only* method whereby a satellite can hope to be picked up is through some sort of inelastic collision capable of bleeding off some of the momentum.

An atmosphere is a case in point. If the asteroid grazes the planetary atmosphere it is going to lose some momentum. If it loses enough it is going to fail to escape and start plunging back. It will hit the atmosphere again and again, losing momentum on each pass until it finally plunges to the surface. A solitary exception exists if the postulated atmosphere happens to be condensing. One or two passes bring the satellite through the atmosphere, but by the third or fourth pass the atmosphere has condensed enough to have shrunk below the pericentron of the asteroid. Now there is nothing to cause further decay, so the orbit is stable.

Rather clearly this cannot have happened with the moon. It is far too massive to have been retarded in this manner. Even if Earth's aboriginal atmosphere had been two or three times that of Venus, there still would not have been enough. The method can work for smallish objects, but not for lunar-sized moons.

In the unrestricted three-body problem there are several solutions which permit satellite acquisitions. Most of these, however, wind up with the newly achieved satellites in retrograde orbit; and the number of methods for picking up direct satellites of considerable size approaches zero. Of the 13 satellites having significant inclinations, 6 turn out to be retrograde, 2 must be listed as anomalous, and only 5 are direct. Of these 5, 4 are satellites of Jupiter: Himalia (6), Elara (7), Lysithea (10), and Leda (13). All four prove to be approximately the same mean distance from their primary and have similar inclinations and compatible eccentricities. Of some interest is the fact that all four of these moonlets have orbits which carry them through the equilibrium point

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where the attractions of Jupiter and the sun are the same.

If a cometary mass passed through this point and was broken up by the conflicting tidal stresses, it is possible to speculate sufficient mass loss from the high-velocity components to permit one or several of the remaining portions to achieve orbit about the planet. If this occurred we should expect to find a closely knit "family" of precisely the sort we do find there. But again, this is not the sort of mechanism apt to lead to moons of any appreciable size.

Of our 13 satellites only one is left—Nereid—out at the fringes of the system and orbiting the only planet with a massive satellite in retrograde orbit; which just happens to offer one of the other possibilities for satellite acquisition.

So why do most astronomers think it likely the moon should be classified as a category II satellite? Because the moon simply does not seem to fit in anywhere, that's why. And if it does not fit then the logical thing to do is look somewhere else.

About a century ago Sir George Darwin, the second son of the naturalist, addressed this question of lunar origins in a series of papers dealing with the configuration of rotating liquid masses. Darwin's initial interest in this question arose from a desire to solve the mystery of binary stars, but he soon realized his mathematics could also be applied to the question of lunar origins.

For at least a half century prior to Darwin's time astronomers had been aware that the moon is gradually receding from Earth. The precise reasons for this are complex and stem from the fact Earth is spinning on its axis more rapidly than it and the moon rotate about their common center of gravity, while the moon is synchronous with it. Given this, the only way the equations can balance is by a slowing of terrestrial rotation, a transfer of momentum from the Earth to the moon, and a consequent acceleration of the lunar orbit. In turn, this acceleration can only translate into a climb to a higher orbit.

Even today the exact value of this gradual recession is in dispute. The math is complicated and depends on a number of uncertain variables. Did the moon have a considerable rotation at the time of capture? If so, then until its rotation became synchronous with its period there would be little or no separation, since the energy would be fully consumed in slowing the axial rotation. And the farther the moon from Earth at the time of "capture," the longer it would take to complete the slowing.

Rather obviously, then, by injecting the appropriate figures into our equations we can come up with values spanning several billions of years. Since Darwin was working with a solar system whose age was then believed to be only 100 or so million years, he cranked in a zero lunar rotation and arrived at the conclusion that Earth and moon must have been very close in the past. As subsequent knowledge refined the age of the solar system, the parameters have been modified to compensate, and we still find that Earth and moon must have been virtually a single body some 4 billion years ago.

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But to repeat, all this is dependent on the values assigned the initial lunar and terrestrial rotations. If, for example, we begin with the assumption that the moon was initially rotating at a clip of, say, two to three hours, we could argue that the recession phase has only recently commenced and the total change in distance amounts only to a few thousand km. It is unlikely, but it goes to show how wildly the figures can be juggled. At the moment about all we can be reasonably sure of is that the existing recession rate works out to some 77,000 km per billion years . . . uncorrected for the energy which must be withdrawn if lunar synchronicity is to be maintained as the length of the month increases.

Returning now to Darwin: his figures suggested the possibility that the Earth and moon may at one time have been a single body having a rotational period of approximately 4 hours. Given this, Darwin went on to observe that the configuration was unstable and the mass would have to pass through a progression of increasingly distorted shapes until at length a portion would separate to become an independent body in approximately Earth-equatorial orbit (Fig. 1). Following this separation, the solar tidal forces would tend to pull the moon down into a roughly elliptical orbit about the Sun-Earth gravitational plane, thus simultaneously *increasing* the lunar inclination with respect to Earth while *decreasing* it with respect to the plane of the ecliptic.

Having made this suggestion, Darwin pursued it in a series of papers, picking up converts along the way. For a while it was more or less accepted among astronomers that the moon is literally the child of Earth . . . with some even going to the extreme of pointing to the Pacific Ocean basin as its womb.

There were numerous objections to the idea, but R.A. Lyttleton deserves credit for putting the final quietus to it, first by pointing out that for the process of fission to occur at all there would have to be a net *increase* in the total energy of the system—with no way to get the increase—and second by observing that both Darwin and his followers had ignored the crucial question of what happens *after* separation. If the fissioned portion escaped, then it would no longer be a problem since it wouldn't be around to tell us it had ever happened. If it did not escape, then the two masses would necessarily wind up with mutually convergent head-to-head orbits. Even if we postulate a reducing atmosphere we find we lack the time to bleed off enough momentum to avoid collision. In short, either the separated portion escapes entirely or it falls right back. No other options exist.

This effectively discredited the whole idea. But to complete the demolition, one of the concrete results of our limited lunar explorations was to demonstrate that the lunar material simply was not consistent with a terrestrial origin. In a nutshell, the Darwin hypothesis is dead, and nothing appears likely to resurrect it.

But the idea did have one interesting by-product. The observation that solar influence would be an important factor in modifying the inclination of an initially Earth-equatorial satellite into an approximately Earth-ecliptical one casts

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Figure 1.

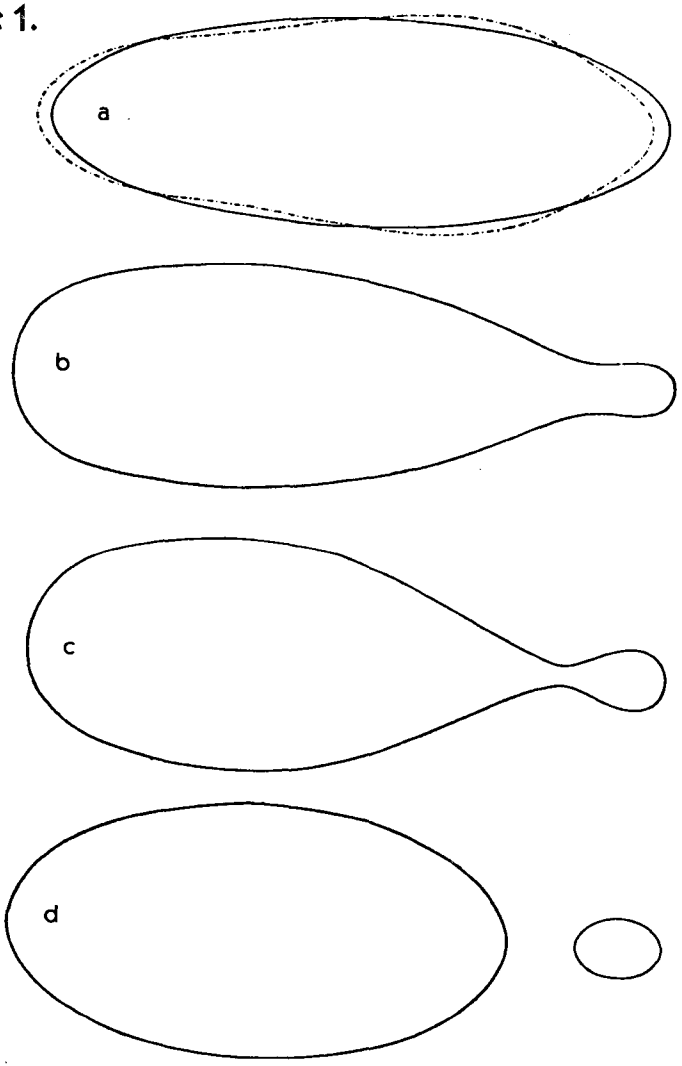

Figure 1—After Sir James Jeans: As speed of rotation increases (a), the equatorial bulge becomes progressively larger. Let the momentum grow still more and a lobe (b) appears. Add yet more momentum and the lobe commences pinching off (c). A final dollop and separation occurs (d), with the excessive momentum having been bled off by the now-orbiting satellite.

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even more doubt on the wisdom of relying too heavily on the importance of a high-orbit inclination of the moon as a means of establishing its origin. We are therefore left with but two alternatives: either the moon was at one time a small, independent planet which was captured by Earth by some as-yet-unknown mechanism or it formed aboriginally as an Earth satellite, albeit most probably with a considerably smaller orbit.

The definitive elimination of the Darwin idea thus gains us a little ground, but at the expense of adding to the uncertainty surrounding the capture hypothesis. The argument premised on the satellite category to which we assign the moon has been reduced to scarcely more than a vague suggestion.

This raises the possibility that we may be looking in the wrong direction. Save for our moon, and the two minuscule moons of Mars, all the satellites of the solar system are remote objects circling one or another of the gas giants. Save for a possible moon of Pluto, all the other satellites of the system are tiny in contrast to their primaries. The moon, on the other hand, is so large in its relation to Earth that a number of astronomers refer to the Earth-moon system as a double planet.

It is therefore possible that, by focusing on the relationship of the moon to the other satellites of the system, we are leading ourselves astray. If the moon can legitimately be thought of as part of a double planet system then we ought to treat it as a planet and compare it with the planets comprising the inner regions of the system, not with other satellites. This approach has received remarkably little attention over the years, but intuitively it seems promising. It may lead to another dead end but at least it is different.

There are also some concrete advantages to be found in this approach . . . providing we know how to make use of them. We know more about the Earth than any other planet. We know more about Mercury, Venus, Mars, and the moon than about any other planets or satellites in the system except Earth. By focusing on those objects of which we have the greatest knowledge, presumedly we ought to be able to come up with more reliable conclusions than from a study of objects of which we have far less knowledge. The question is, what do we focus on? What sort of data can help us in our search for lunar origins?

One potential approach takes up the question of lunar density. Astronomers have known for years that the moon appears to be abnormally undermassive for its size. Estimates of the precise discrepancy between the observed mass and ideal mass vary wildly, but there is virtually unanimous agreement that the observed mass is too small. In fact, this has been employed as an argument for the capture theory. According to this line of reasoning, the moon obviously cannot consist of the same proportionate mix of elements as the Earth or it would have an appropriate density. Since it possesses an unEarthly mix, it must have originated somewhere else in the system and have been captured.

But this argument seems a trifle premature. Rather than accepting it out of

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TABLE II

PLANET	RADIUS (km)	MASS (Earth = 1)	MEAN DENSITY (gm/cm^3)	SURFACE GRAVITY (cm/sec^2)	FLUX ($\times 10^{18}$)
Mercury	2 439	0.055	5.46	356	21.943
Venus	6 052	0.815	5.22	850	322.962
Earth	6 371*	1.000	5.52	982	398.820
Moon	1 738	0.0123	3.34	162	4.899
Mars	3 388*	0.108	3.94	373	43.037

*NOTE: Both the Earth and Mars have an appreciable oblateness, but most texts give the equatorial diameters or radii. The values used here represent the mean radii for these planets. Mercury, Venus, and the moon rotate too slowly to show any oblateness.

SPECIAL NOTE: Despite recent advances in astronomy of the solar system, very few texts are in complete agreement so far as densities, radii, and masses are concerned. Some recent texts, for example, assign Earth a mean density of 5.497, which derives from Spencer Jones's 1941 determination of the solar parallax and the average of surface gravity reported at various stations. Since we have employed a mean radius for Earth, the 5.52 employed here is essentially identical to 5.497 applied to an Earth whose equatorial radius of 6.378 has been cranked in.

hand perhaps we ought to examine things more closely. Take the five inner bodies, which among them comprise the only significant masses in this region of the solar system, and then make comparisons. If the results prove indecisive we will be no worse off than before. On the other hand, if we can establish that the moon is clearly underdense *and* that there is no place for it in this part of the solar system, then we must conclude it to be a capture, regardless of the difficulties involved. At the other extreme, if we can establish that it is underdense but that it still *must* have formed in conjunction with Earth, then we must consider it aboriginal.

Table II provides us with a general comparison of the five bodies. The first five columns are routine. The sixth requires explanation. Trying to make a direct comparison between a planet with a radius of 6,050 km and a density of 5.22 and a second planet with a radius of 6,371 km and a density of 5.52 is an exercise in futility. We already know that, as the pressure of the overburden increases, it compresses the material at the core and increases the density accordingly. So is the lesser radius of

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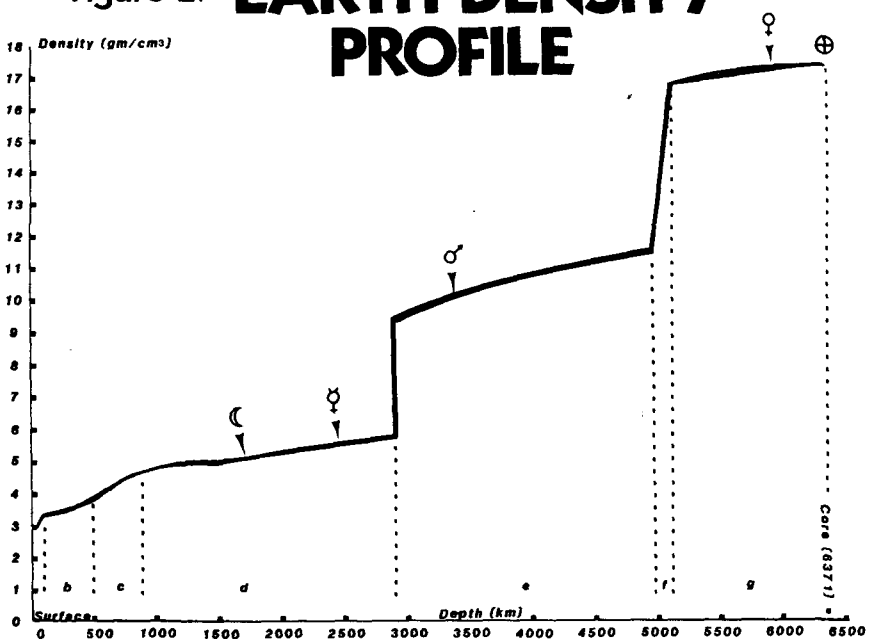
Venus sufficient to account for the observed density difference of 0.30 between it and Earth? We need some way of making this sort of comparison.

Column six is what permits us to manipulate the data. We calculate the number of cm^3 in the planet, multiply by the universal gravitational constant of 6.67×10^{-8} dyne cm^2 gm^{-2}, and multiply the result by the mean density to obtain a gravitational flux value. In the case of Earth we arrive at a number 398.820×10^{18} as an example.

Purists may argue the precise meaning of this number, but it is irrelevant for our purposes. It clearly represents a *usable* number. It is unique to each planet and derives immediately from the characteristics of each. If instead of this we said the mass of the planet is the equivalent of so many kilograms we would be quite correct, but would find it considerably more difficult to manipulate the data effectively, since we would have to spend much of our time juggling our numbers back and forth. The flux value is more convenient so we employ it in preference to the other.

To begin with Earth itself: from anomalies of its motion with respect to the moon, we can determine our moment of inertia and get a rough idea of the mass distribution beneath our feet. A homogeneous Earth, for instance, can

Figure 2. EARTH DENSITY PROFILE



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be calculated as having a moment (C) equal to 0.4 of the product of the mass times the square of the radius. But actual observation gives us a value of only 0.3335, proving the existence of an inward concentration of mass. Added to this we have a fairly detailed picture of the density gradient gotten from the study of seismic waves. The result is a reasonably consistent profile of Earth's density/depth ratio, as given in Fig. 2.

The figure itself is taken directly from the mean of K.E. Bullen's two solutions, so it is incorrect in detail but essentially very close. Both solutions were mathematical constructs, one assuming a smooth-line curve from the surface to the center while the other postulated a single, abrupt discontinuity upon entering the "e" layer at the outer boundary of the liquid core. Since there is evidence of a solid, inner core of markedly higher density it is obvious neither of Bullen's solutions was correct so averaging-out has to be—at least in principle—incorrect. The point is, this averaging gives us some figures which correspond very closely to physical observations from many different sources, while Bullen's solutions were constructs from the start. In other words, yes, we're wrong; but no, we're right. We can be reasonably confident the figures we have here are well within a single percentage point of accuracy.

The steadily increasing density as we approach Earth's core region may be attributed to either or both of two factors: either the physical material is inherently more massive, as in an iron core, or the pressure of the overburden has compressed an inherently less dense material into a more massive form. It is generally agreed that the "a" layer, or crust, consists mainly of aluminum silicates so this is frequently referred to as the *SiAl* layer. The "b," "c," and "d" regions are believed to consist mainly of basaltic-type matter composed of magnesium silicates. It is often referred to as the *SiMa** region, and evidence suggests that the discontinuities which mark the boundaries of these layers are merely phase changes caused by the steadily increasing pressure.

For the inner core region there is considerably more doubt. At the moment the preponderance of evidence favors an actual change of material between the "d" and "e" layers, but the evidence is scanty and inconclusive and some authorities argue for additional phase changes compressing ordinary, basaltic-type matter to densities unanticipated by our surface technologies.

For our part, we are inclined to take the middle ground and suggest that the proportion of heavy metals increases in this area, but that it is not a case where a specific mix excludes all others. Despite this, and in deference to tradition, we will refer to the "e," "f," and "g" layers as the nickel-iron or *NiFe* zone, to provide a clear distinction between it and the SiA1 and SiMa layers.

Table III gives a detailed numerical

**Seismologists and others concerned with Earth's interior do not necessarily feel themselves obligated to follow rules laid down by chemists. One might think silicates of magnesium would be referred to as* SiMg, *but* SiMa *it is, and has been for well over a half century, like it or not.*

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TABLE III

HEIGHT FROM CORE (km)	LAYER	DENSITY (gm/cm³)	FLUX FOR SEGMENT (x10¹⁸)
171		17.33	0.024
371		17.30	0.223
571		17.26	0.625
771	g	17.18	1.306
971		17.06	2.179
1171		16.96	3.270
1250		16.85	1.635
1389	f	14.20	2.883
1571		11.450	3.831
1771		11.320	5.305
1971		11.170	6.561
2171		10.990	7.908
2371	e	10.825	9.365
2571		10.630	11.014
2771		10.425	12.474
2971		10.195	14.093
3171		9.940	15.720
3371		9.670	17.350
3473		9.480	9.492
3571		5.657	5.764
3771		5.571	12.589
3971		5.473	13.751
4171		5.373	14.930
4371		5.273	16.127
4571	d	5.166	17.314
4771		5.063	18.521
4971		4.951	19.695
5171		4.826	20.806
5371		4.721	21.991
5471		4.627	11.397*
5571		4.527	11.566
5671		4.383	11.608
5771	c	4.196	11.511
5871		3.981	11.307
5971		3.717	10.922
6071		3.577	10.869
6171	b	3.497	10.982
6271		3.411	11.064
6338		3.341	7.457
6371	a	3.000	3.351
			398.819+

*NOTE: The interval changes to 100 km at this point.

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breakdown of Earth's interior. Essentially it is no more than an onion-peeling process where we strip off first 100 and then 200 km layers, with breaks where major discontinuities or phase changes occur, then determine the contribution of each layer to the total flux. The result is probably as accurate an analysis as possible given our present knowledge and is probably correct to within one percent.

Referring once more to our profile of Earth's gradient in Fig. 2, we have indicated where the moon, Mercury, Mars, and Venus would have their cores if we had made separate graphs for each. Now suppose we make a preliminary assumption that in all five planets the core regions are compositionally the same as the SiMa layers, and the cause of abrupt density increases is phase-changing. This is not a statement of belief one way or the other. It is merely a convenient approach to give us a first approximation.

But given this assumption, we ought to be able to superimpose the lunar density profile atop the Earth profile down to the 1738-km mark and then break it off there. Similarly, we should be able to do the same with Mercury, Mars, and Venus. When complete, all five bodies should be in reasonably close agreement. These would represent the "model" fluxes we should expect from each planet with the assumptions given. Since the presentation of four complete tables similar to Table III would be superfluous here, we will content ourselves with giving the lunar calculations and merely show the results obtained from the others. Table IV gives the lunar calculations.

They are frankly disturbing. Observation proves the moon to have a mean density of 3.34 and a flux level of 4.899 x 10^{18}, but here we come up with a density of 3.93 and a flux level of 5.767. This makes the moon only about 85% as massive as we would expect if our preliminary assumption is correct. Certainly there is no way that this model can permit us to assume that the moon is compositionally similar to Earth. Accordingly, either our preliminary assumption was incorrect or the moon is indeed fundamentally different. But when we look at the results of our examination of the other planets (Table V) we find a real surprise. With a model flux of 15 versus an observed total of nearly 22, Mercury turns out to possess 42.5% more mass than anticipated. Venus proves somewhat lacking in mass . . . running some 97.2% of anticipated. Mars comes in at 93.2% and the moon at 84.9%.

This is an uncomfortable finding. If we had found anything like a systematic discrepancy . . . say where everything wound up 10% overdense or 10% underdense . . . then we could conclude we had made some error in the procedure. But here we have something almost random. Mercury is markedly overdense, Venus slightly underdense. Mars is considerably underdense and the moon highly so.

One thing is evident in all this: whether our approach is wholly correct or not is not certain. But we can be certain it is sufficiently correct to permit us to conclude that no simple, uniform

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TABLE IV

HEIGHT FROM CORE (km)	LAYER	DENSITY (gm/cm³)	FLUX (X 10^{18})
138		5.063	0.003 7
338		4.951	0.049 8
538	d	4.826	0.157 9
738		4.721	0.530 2
838	———	4.627	0.241 1*
938		4.527	0.299 5
1038		4.383	0.358 9
1138	c	4.196	0.416 6
1238	———	3.981	0.471 2
1338		3.717	0.517 1
1438		3.577	0.577 8
1538	b	3.497	0.649 2
1638		3.411	0.723 5
1705	———	3.341	0.524 3
1738	a	3.000	0.246 0
			5.766 9+

*NOTE: Interval changes to 100 km at this point.

TABLE V

PLANET	OBSERVED TOTAL DENSITY (gm/cm³)	OBSERVED TOTAL FLUX	MODEL TOTAL DENSITY (gm/cm³)	MODEL TOTAL FLUX
Mercury	5.46	21.943	3.89	15.403
Venus	5.22	322.962	5.35	331.188
Earth	5.52	398.820	5.52	398.820
Moon	3.34	4.899	3.93	5.767
Mars	3.94	43.037	4.25	46.166

DENSITY DISCREPANCIES

Mercury	= 1.425
Venus	= 0.975
Earth	= 1.000
Moon	= 0.849
Mars	= 0.932

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adjustment in our approach can reconcile these differences. We have to start on a case-by-case analysis and see where it leads us. No other options remain.

For Mercury we have a simple solution. Being so close to the sun, it has undergone an enormous amount of thermal outgassing over the eons. It may be doubted, however, whether there can have been enough outgassing to account for the magnitude of the effect. Once a planet has fully formed, the lithosphere becomes a powerful insulator, and outgassing effects are pretty well confined to the top km or so. As the outgassable material departs, we have a non-outgassable slag left on the surface to insulate against further loss, so the effect would be minimal. But this limiting effect vanishes if we postulate the sun began its radiative career *before* Mercury completed its condensation. With this simple, perfectly reasonable assumption our problem vanishes and from there we can legitimately expect the resulting planet to be markedly overdense.

This wraps up one of our problems, but not the rest. No such easy solution exists for Venus or the moon. We can perhaps make a small case for Mars by extending the Mercury argument. If all the inner bodies completed their condensation after the sun commenced radiating, then the same mechanism which blew the lighter matter away from Mercury would have been operating on them too. And since Mars is the most remote of the inner five, it would have lost a smaller percentage of this material than the others. Additionally, it would be a potential recipient of some of the lighter elements being blown out of the Mercury, Venus, and Earth orbits. Mars would therefore stand to benefit most while simultaneously being least hurt by this process.

If we wished, we might even argue that planetary condensation extended over a period of several millions of years, with some condensing relatively early and others much later. With this approach we might suggest the moon was the first of the inner five to condense and so lost virtually none of its lighter material. Then came Mars, followed by Venus, Earth, and Mercury in that order. But this leads us to the startling conclusion that the moon must have captured the Earth, since it was there first! And since this is an impossible conclusion on gross mass considerations alone, we then find we must modify the sequence to read: first Mars, then Venus, Earth, and finally Mercury, with the moon having been captured at some later date as a relic of a condensation elsewhere in the solar system.

Here we are again, right back at square one, faced with an acquired moon and no way of having acquired it. Besides, while this may be a workable approach, it is also an uncomfortable one, cumbersome and unconvincing. The whole idea of picking out first one planet and then another, spacing their condensations over a span of possibly several millions of years in hopes of having precisely the right quantities of lighter mass material either being blown away or acquired, seems remarkably forced. We might call this a last-resort hypothesis; the sort of thing to drag out

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and lay on the table after everything else fails.

So far as we are concerned here, if we assume an approximately identical date of condensation for all five bodies . . . say within 50,000 years or so after the sun began radiating . . . we can account very nicely for Mercury and we can partially account for Mars. But we cannot account for Earth, Venus, or the moon, except perhaps to suggest Earth is somehow representative of an idealized norm since we have defined it as our reference base.

But this leads us to an interesting idea. Are we correct in making Earth our norm? It is our home so we think of it as normal, but we have also observed that the Earth-moon pair is possibly correctly considered a double-planet system by many astronomers. If it turns out they are right, then we are unique in the solar system, and being unique we can scarcely be "normal."

Conceivably this is our long-hoped-for clue. Perhaps we have been caught in a faulty perspective all along. Rather than Earth, possibly Venus is the real norm, and we are an exception. Mercury becomes extra-massive because of its close proximity to the sun, and Mars is somewhat underdense for the reasons just mentioned. The Earth and moon are actually a double planet, having formed more or less together from a common cloud but with the Earth having acquired a disproportionately large share of the heavy elements, to leave the moon markedly deficient.

The mechanism for something of this sort is basically fairly simple. We have a swirling cloud of material concentrated at the interface between vortices . . . all, of course, being merely part of a far larger cloud from which the remainder of the system is condensing. The core of such a cloud becomes a region of relative quiet and the heavier materials gradually migrate toward it. The planet commences growing. But it is still surrounded by masses of gas and miscellaneous debris. Let a few chunks of this debris collide and cohere while remaining in orbit and we have a growing moon; a moon in which the heavier elements are systematically lacking because the primary planet grabbed them off first.

If this assumption is correct we have not only an aboriginal moon but also one in which inclination is only a relatively minor factor. Being so close to the sun, it is not surprising the seed material for the moon should have an inclination somewhere between ecliptical and equatorial. It begins to look as if we may have our solution, but how do we go about testing it?

This too is a challenge. We have an attractive hypothesis but little else. There is, however, one potentially useful avenue. If the idea is correct, there should be one clear signature of the event. The Earth and Moon together represent the material contained in the interface region. If the secondary condensation nucleus had never appeared, then presumedly the resulting planet—which we may call "Earthoon"—would have contained all of this material. We would find the density profiles for Venus and Earthoon in agreement or at least in fairly close accord, since we would have to allow for the loss of some extra

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lighter-mass matter from the actual Earth-moon system (caused by the tidal pull of the moon as it lifted gasses from Earth's atmosphere to heights where radiation pressure and the solar wind could drive them away). In short, if we smeared the moon evenly atop Earth and then recompared it with Venus, we should find the discrepancy largely eliminated.

This is admittedly an inconclusive approach. Substantial agreement between Earthoon and Venus does not prove the truth of our hypothesis, but a failure to achieve any reasonable agreement can be used to disprove it. In effect, this approach can be employed to prove us wrong, but it cannot prove us right. Still, it's the best we have, so we may as well use it.

In calculating the character of our Earthoon, only one element is known with precision. The flux value is merely additive, so we know Earthoon would have a flux of 403.720×10^{18} regardless of any other variables. The change in planetary radius is dependent on the sort of hypotheses we wish to enter. If we ignore compressional factors and merely spread the moon evenly atop the surface, we find the radius is increased by 43.1 km. At the other extreme, if we postulate that any access of material is translated to a corresponding increase in core density, we find we have increased our mean radius by a total of only 8 km.

These are our limiting values. An Earthoon would have a radius falling somewhere between 6,379 and 6,414 km and a mean density ranging between 5.476 and 5.567. Unfortunately our existing knowledge of the core regions of Earth do not permit us to be more precise than this, so we find it impossible to arrive at a firm analysis of an Earthoon-Venus relationship. But this does not mean we are incapable of arriving at a reasonable approximation.

We do it with a backhand stroke. Rather than adding Earth and moon together to arrive at a new profile, we merely add the moon's existing flux to that of Venus and see how much of the discrepancy the moon is capable of absorbing . . . assuming conditions are ideal. To the observed Venus flux of 322.962, which was 97.516% of our model, we add the lunar flux of 4.899 and arrive at a value of 327.861, which is 98.995% of the model. This brings us to 1.005% of the anticipated flux and eliminates over 60% of our discrepancy. The residuum left unaccounted for works out to something on the order of two-thirds of our moon.

We can hardly call this a great agreement, especially since the bit of adding the moon to Venus tells us only what the potential correction might be. It says nothing of what the actual correction was. We can only be certain that the correction acts to eliminate at least a portion of the discrepancy. We may also speculate that most of the lunar potential would be realized, because we know it consists of lighter-weight material and probably conforms pretty closely to the *SiAl*ic crustal material of Earth. This would keep it on top of our crust and serve to decrease the mean density of the upper regions of Earth, which is

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where we would want to see it decreased.

There is no way we can really call this a positive solution to the problem of the origin of the moon. But it does suggest we can make a good, solid argument in favor of an aboriginal moon . . . which means we need no longer find ourselves endlessly recycling back to a capture hypothesis and all the theoretical and dynamical difficulties presented by it.

What is perhaps more important, the model offered here is basically attractive. It gives us a single, comprehensive schema to account for the main characteristics of the whole inner region of the solar system without the need to postulate special captures of moons or planets which just happen to be overdense or underdense without reason or explanation. And this is something no earlier model has been able to accomplish. ■

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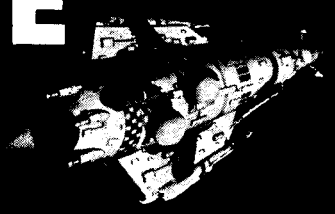

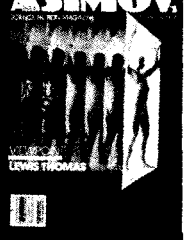

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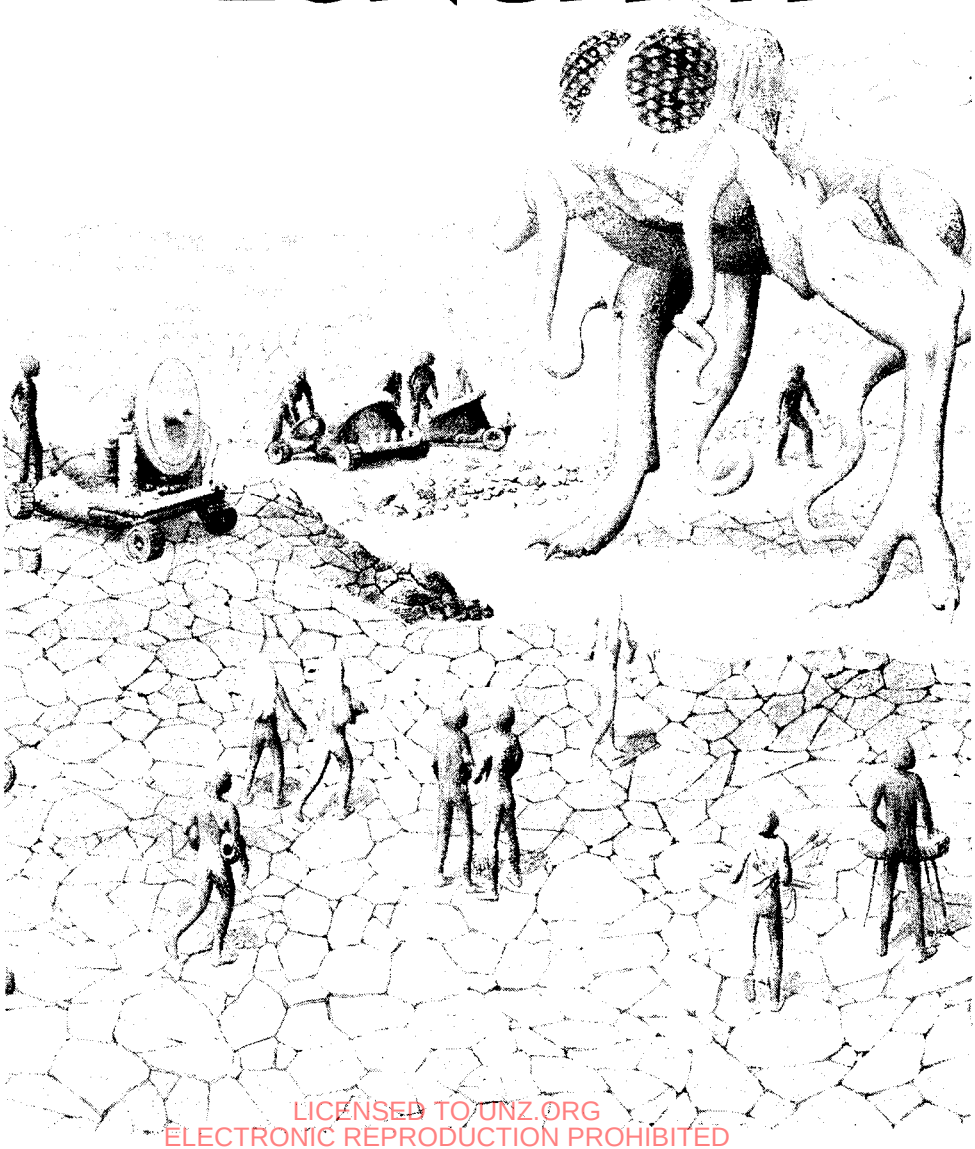
Some adaptations depend mainly on patience—lots of patience.

Jayge Carr

LUNGFISH



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LUNGFISH. 1) Order *Dipneusti*. These now-extinct Terrestrial aquatic genera (*Neoceratodus*, *Propterus*, and *Lepidosiren*) had air bladders with direct connections to the pharynx so that they could be filled with air gulped in through the mouth to serve as a lung; thus, they could live out of water for comparatively long periods of time. Their habitats included transient rivers, lakes, and swamps. Many aspects of their structure and development were amphibianlike rather than fishlike; their precise relationship to the ancestors of all Terrestrial land vertebrates is a matter of some controversy, but that the relationship was very close is undeniable. The average specimen was about a meter in length. . . .

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"A thirty-thousand styear summer? *Lovely.*"

Emmet nodded. He was a light-planet adapt, long bones sparely clothed in scant black-ruby skin. "We haven't hit the worst of it, either. In another thousand styears, I predict the temperature will be hot enough to make lead run like water."

Ariel shook her head, soft wafts of lint-white hair drifting with the movement. "It seems impossible."

"Unusual," he corrected her. "So extreme. You'll have to ask the astros what kind of solar variability could cause a cycle that long with that spread of temperature. All a geochron like me can do is examine the cores and report on what they show. The cycle's established now; has been for tens of millions of years. It started shorter and milder —you can see the progression clearly—but it's stable now, from all the evidence. Now and probably from now on. When the astros come up with an explanation, maybe they can predict how much longer it'll stay stable—"

Ariel the Generalist smiled slowly, making her look even more like a young and elfin Alice, except that the original Alice would never have had three manes of soft hair ringing face, shoulders, and hips—and no child could ever hope to become a Generalist. "Are you going to explain unstable equilibrium to me again, Emmet?" she asked.

The ruby undertone of his skin deepened, and he looked anywhere over the cracked baked landscape instead of at her. "No. I was going to explain why I don't feel orbit-juggling would be a viable solution in this case."

She pulled the tube of the protecsuit up to her mouth and took a long sip. This was a roasted-dry planet, so hot and a parched that a single step without the protection of the suit would leave a desiccated corpse. So each of the humans walked in a cloud of water vapor. Masterpieces of miniaturization rode on their hips, producing water vapor from the CO_2 in the atmosphere, broken down and combined with the hydrogen byproducts of its own fusion power source. Full units with fields that wouldn't let a molecule in or out would have been mandatory on a planet where there was possibly dangerous life, micro or macro; but the fields cost more energy than the water vapor spilled in their absence, so the team was merely protected against the solar radiation and the dryness. "A hundred thousand styear-plus cycle would seem to give the colonists time to try for a more—" A childish giggle; but the cold light eyes assessed him shrewdly. "—more *permanent* solution."

"It's not the length of the cycle, it's the amplitude. We can adjust it now, at considerable expense of energy. But in a few hundred styears . . . the colonists won't appreciate being periodically blasted into a new orbit so they won't fry—or freeze, when the cycle starts back down—at all."

"I see." She nodded. "I expect you to come up with a usable solution."

He looked up. The ocher sky was thick with lemon-colored clouds that he knew weren't water vapor. "I could make it rain easier."

"Humph. All right, then—how long would automated mining equipment last, assuming we don't bother to meddle."

"That's not my field." Long enough,

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he thought to himself, to rape the crust down past the Moho.

I stir. The shell seems appropriately weak, but oddly unbrittle. Yet other minds have wakened, I hear them faintly, smudged with the turbidity of arousal, slow and impenetrable. Perhaps it is still too soon, and I have been goaded into premature consciousness by impatient fools. I am cramped, curled in the unyielding spore. The minds, though unintelligible, are loud and annoying. I grumble angrily to them, Be quiet, and let the rest of us sleep. They are silenced, and I can drift back into comfortable oblivion.

Emmet was involved in a series of remote experiments, his fingers dancing over the pressure-sensitive keyboard that controlled the waldoes doing the actual experiment, his eyes flickering over the series of screens that showed both relayed visuals and raw and analyzed data. He was muttering disjointed curses under his breath.

Next to him worked a geomorphologist named Domino, a tall woman graceful as a perfectly elliptical orbit, and hard as the 1000+ carat black diamond she kept as a faxweight. She also had exceptionally fast reflexes, which is all that saved Emmet from a nasty set of bruises when he suddenly slumped over his controls and slithered down like a stick puppet with all its strings cut.

"My *head*—" Emmet stirred and moaned.

"What's the matter?" Domino manhandled him into the nearest tempaseat. "Shall I call a medico?"

"I—my *head*—like somebody hit me. . . . "

Domino preferred to work physically Linked onto her equipment, but she had been disconnected, taking a short breather, when Emmet fell. If she had been connected, he probably would have fallen unnoticed.

Now she leaned over to the communicator/analyzer/computer /controller/etc. panel, and inserted the translucent input tube in the socket above her ear in one easy motion, the heel of her hand slapping a large red button as it dropped.

A voice spoke simultaneously in her ears (through the panel) and her mind (through the input tube). "Is the victim breathing on his/her own?"

"Affirm." Domino frowned. This wasn't SOP for a medalert.

"Then offcircuit and don't bother us! Call only if victim stops breathing."

"I don't under—"

"Offcircuit! Over twenty crewmembers have stopped breathing. OUT."

Despite the number of victims, the medicos had reacted quickly, and they only had to quickfreeze four crewmembers because of damage uncorrectable with the simple ship's systems.

Predictably, the captain wanted the source of the mysterious "epidemic" located and neutralized. But the lack of repetition made for difficulties. Ariel produced several possible causes, of which the most likely seemed to be a sonic of some sort caused by the settling and/or cracking of the nearby strata. All crewmembers were issued counter-resonators before being allowed offship, and the experiments were resumed, full blast.

I stir again. My mind itches. What do these discourteous impatient ones

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intend? Can they drink rock? I can feel the heat through the shell. Surely, surely, it is still too soon for emergence. Yet I can hear their minds, dirty smudges all over the place. I listen angrily, hoping to identify the pithless ones. After Emergence, I will thirst and hunger; and such discourtesy should surely put uators beyond all the Protections.

How can one sleep with those amorphous blotches marching around, disturbing one. Sobeit. I will arouse, and tear through the shell whether it be properly weakened or no; and the juices of those selfish splutterers will carry me over until the proper awakening time.

"What don't you like about this world?" It would take a while for Domino's digger/analyzers to get back down to the level she'd been working at, so she was kibitzing Emmet. "Or do you think Ariel's wrong about the sonics?"

"Ariel wrong?" he chuckled, his eyes still fixed on his screens, his fingers flowing over the input. "The universe'll end first. No, it's just—I don't know. But every now and then, I have this feeling about a world, the hair on my neck sort of curling. . . . And every time, every time, that world has presented us with a surprise package of one sort or another."

"And not good surprises, either, eh." She spoke absentmindedly, the clock in her mind telling her it was almost time to take direct control of her experiments.

"Never. Always bad ones. Deadly."

"But this world's dead. No iife at all. But—this change you said it's going through. Could that be the problem?"

He shrugged. "Possibly. I've been looking. But the danger's not necessarily in my field. It could be anything. Just—danger."

"Is that why you filed an official Pass-this-one-up Recommendation?"

"No, I—" Suddenly fierce. "I'd like to Pass them all up!"

"Wha—now you sound like that pathetic bio who cracked."

"It was something he said that started me thinking—no, not the killing, that doesn't bother me. Animals die, all the time; does it matter whether we do it, or their own environments?"

"Compete or go under."

"Exactly." His fingers stopped, the screens froze, and he turned and faced her. "Compete—or go under. But maybe you can compete *too* well. Maybe an apparent victory in the short term is a long-term defeat."

She smiled, rearranging the sapphire and scarlet circles that radiated out from her mouth to cover every square centimeter of exposed skin. "You have about one stimmet to explain that statement."

"Lungfish. You know, long time ago on Manholm, there were no land animals, just water dwellers. And the ones who could compete less effectively got pushed out of the ocean, into the freshwater streams and rivers and marshes. And sometimes those streams and so forth'd dry up, leaving the animals stranded. And some of those animals, finally, evolved to the point where they could breathe the air. Lungfish. Animals with gills, water dwellers who could also breathe air. And some of those lungfishes, when their water dried up, were able to struggle to the next water. And some, the less effective, merely struggled. But it was the more

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effective ones who remained lungfishes, who went back in the water. It was the less effective ones who stayed on land, who were the ancestors of all the land animals that developed on Manholm."

"So?"

"So we're actually the descendents of those less effective lungfishes, the ones who couldn't do quite as well, and further back the ones who couldn't compete in the huge oceans and were driven into the fresh water, the smaller, more unpredictable, more dangerous environment."

"I don't see the point."

"We're the new lungfishes, us, the human race. Only our puddles aren't drying up; we're overpopulating them. And instead of trying the land, we just keep looking for new puddles. New planets. And if they aren't right for us, we change them, or ourselves, a little to fit. Planets! Do we really need planets!"

"I'd say so," her voice was dry. "You know the figures as well as any of us."

"Do we?" he insisted. "We're looking at puddles, when all that beautiful land is around us, waiting to be settled. We're looking at planets, which are finite, when we have all of space to expand into!"

"You—you're *insane!*"

"Am I? Think about it. You and I, we spend most of our lives in space *now*. We adapt men for planets—how much more difficult to adapt them for space? We turn raw worlds into giant megalopolises; how much harder to convert that material to space-going colonies instead?"

Wordlessly she shook her head.

"The descendents of the lungfish who went back to their puddles were almost extinct when the descendents of the lungfish who stayed on land were spreading out into space."

Her solution for any physical or psychological problem was the same. "I think you ought to let Smiling Willow—aiyeeee!" Domino's scream was echoed by all the scattered crewmembers who happened to be looking toward magnetic north.

Emmet whirled.

It was BIG, it had a dozen limbs ending in claws or tentacles and enormous multi-faceted compound eyes with the hot angry glow of molten iron in every facet, it was encased in segments of white glittering armor; it was the quintessence of every human nightmare for a thousand thousand years. It wobbled toward the camp on unsteady legs.

Because this world had been rated uninhabited, the camp had no defensive perimeter. It simply sprawled out in whatever direction a crew member had found it handy to set down equipment. There was a protective force field that could be easily activated, but it was only set for natural disasters: earthquakes or the like. It would take only a short time to reprogram it for protection against native life. At least six of the crewmembers started the reprogramming sequence, but it was academic; the monster was inside the perimeter of the field already.

None of the crew members was wearing hand weapons, but there were plenty of waldoes and plenty of potentially lethal equipment handy. Domino reacted the fastest. One of her waldoes poured a container of fluid over the beast.

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"Aqua regia!" Domino said. "That should take care of *that!*"

Fluid. I sucked greedily at it, letting not even a precious drop run off my armor. Then I remembered. I had emerged from my shell, and realized, too late, my mistake. It was not beginning of revival, but the beginning still of the long drought. I was doomed. My shell was broken, and I couldn't make another. Any intelligent being knows that death is inevitable, yet I was much too young still to embrace it with the proper fervor. So—I would find these annoying, unintelligible minds and take them with me.

But I was losing fluid rapidly. I had done the only thing that would prolong my life. I shifted to autonomic mode, shutting down all nonessential systems, leaving my body to fend for itself. Perhaps it would locate moisture beyond the reach of my senses. Perhaps the extra time I had obtained would enable my body to find a source of moisture, enough so that I could at least leave a template, warning my fellows of this unheard-of danger.

And—my gamble had worked. I was immersed in lovely fluid. I was still wearing drought armor, and as I absorbed the lifestuff, I filtered out usable elements for possible transmutation later. If I had a later.

"Give him another dose of the aqua regia, Dom," snorted a lanky climatologist. "He seems to like it!"

"If that shell's acidproof," Domino grabbed another container from the "hands" of a non-mobile mechanical and stalked forward, "let's see how it likes alkali!"

BLaaaaah! *What a vile taste! What an unspeakable flavor!*

I looked around again, tried to locate other people. No use; the odd displacements I had seen as soon as I returned to full consciousness continued to move about, but integrate the mosaics as I could, I couldn't make any sense out of the images. Could I be seeing some sort of refraction mirage? A product of the drought? Yet the odd itchy minds were still alert and, I was sure, near. I had to locate them. . . .

I spread all my senses out. . . .

FLUID! All around me! Everywhere! I swept my tentacles toward the nearest source—

"IT'S GOT DOMINO!"

It seemed to be a small and discrete source. I spread my dorsal and pectoral membranes around it so that no precious drop would be wasted. To my amaze, the source actually seemed to move upward and away. Instinctively, I completed the englobement. I could feel weight on my lower membranes, and I shifted so that I was supporting it. Could I actually move with this oddity? How long would it continue to produce life fluid? Could I—something hot scorched along my lower pelvis—

"Careful with that monster—you don't want to catch Dom!" A laser cutter had been angled so that it hit the back of the monster. Another scientist was maneuvering a microwave projector to get it on target. A third had jimmied the safety caps off a power cell's terminals and was cautiously circling the white creature. From within the shroud of pliable flesh, thumps and furious shouts told

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them their crewmate was still alive—and kicking.

Oddity upon oddity. I have the water source, but I still cannot locate the others, though my mind itches; worse, intense and localized heat is drying my armor out faster than I can drink from the source. But—the source is within my grasp, it is movable. If I return with it to my nest, even though my shell is broken, I will be away from the unnatural phenomena of the drought that fooled me into thinking I heard other minds and that is still uncomfortably itchy and filled with too-bright tangs of heat and other energies.

So—

I will return to my nest, drain the source completely, and form the template to warn my fellows of these new dangers. Thus will my death encompass purpose.

These mosaics are very odd. And refraction images or no, how my mind itches.

The scientists waited, not at all patiently, for some equipment to be chuted from the ship. From continued muffled curses, they knew that Domino was still conscious.

When the thing started moving, they had all attacked it with hands and waldoes; it had been like tearing at a moving statue of solid diamond. They continued to crowd around as the thing moved away, majestically disregarding their efforts.

When it finally stopped in this little hollow, they had tackled it again, with as little results as before. Now, prying, plotting, or cursing, according to individual temperaments, they waited.

"Are you sure it's alive?" Emmet muttered to a brawny biologist drab in a monotone lilac skin.

The biologist sniffed. "It didn't like the lasers; irritability is the classic test for life."

"I only meant—maybe a lost civilization, a programmed mechanical of some sort . . ."

The biologist shrugged. "At this stage, what's the difference? We've got to get Domino out of there before her powerpack goes, or the thing decides to try mushed Dom for lunch."

Emmet was pacing up and down, looking more and more like a walking skeleton. "If this doesn't work . . ."

It had been the biologist's idea. "Then we can try lasers again, or whatever. But that thing seems to have a hide of solid collapsium. Anything that could get through it, could fry Domino into a cinder when it does."

"The weird thing is," Emmet stared at their oblivious adversary, "I don't think it sees us at all. It doesn't seem to be aware—"

"Compound eyes," the biologist was talking nervously, trying to take his mind off of what was happening to Domino. "You think everything sees like you do? Your way is the natural way, the Only Right Way. No, compound eyes see in bits and pieces, puts those pieces together to form a pattern. Like a mosaic, sort of. But if the pattern isn't close enough to something it already knows, it probably has a nervous censor to screen—"

"Are you saying that *thing* is intelligent?"

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"Not necessarily. The screening could be instinctive. The nerves themselves are—call it programmed. They simply won't accept certain forms of data. If the eyes see something that doesn't fit a known pattern—"

"Pfaug!"

"Happens all the time. Predator that catches prey on the run or on the wing is alerted for movement, has to ignore unmoving objects which'd just distract it from its prey. You can put some of them in the middle of a pile of dead prey, and they'll starve to death, because there's nothing moving, and they only notice or attack movement. Like this thing. It literally doesn't see us."

"So—why'd it grab Dom?"

"Who knows. Maybe she smelled good, somehow. Maybe she appealed to an alien sense we don't even have an analog of. Maybe—"

"Step aside, hums," said a petite chartreuse-skinned fem with a pointillist pattern of ocher and chocolate all over, including depilated skull. "We've got eight of these scruddy beasts to set up—"

"Eight?" The biologist was outraged. "The plan called for twelve, minimum."

"Look, hum. You may be the think-tank around here, and I may be only a scruddy engineer, but eight was all we could cannibalize in a short time. You want twelve, you can have them—in five or six watches. For now—it's eight, kiss 'em or kiss 'em off."

"Curse you, there's a woman trapped in there!"

"I know, hum. And if she were my prime genetic donor—and for all I know, she might have been—it wouldn't make any difference. This is *it*."

"Oh. Well. What flow rate can they give me, total?"

She told him. He chewed his lip, turned to Emmet. "Is that enough—you calculated the rate of runoff for me."

Emmet shrugged. "Have we a choice?" The muffled curses had diminished to weak, sporadic rumbles.

"Now or never, then," the biologist said. "So—now!"

Eight fountains of water arched up into the dry air and converged over the monster, noticeably lessened by even that short passage through the parched air. They splashed down on the creature with stunning force, and there was a deep ground rumble of noise from the being. It was in a shallow dip, and broad cracks a man could stick a boot in radiated out from the tortured baked earth. The water pounded down, filled the cracks, ran off, ran down—and began to fill the hollow around the glittering, rumbling, thrashing monster.

"It—it's melting!" someone exclaimed.

"I knew lots of water would do it," the biologist was smug. "To anything adapted to this, water would be a poison."

The monster, sprawled flat and still thrashing, lay in the middle of a shallow pool. But as they watched, it seemed to—shrink, to lessen, to diminish. The water stopped rising as it continued to spread out through the flatter part of the small hollow, but the monster was going under. . . .

Domino surged up out of white membranes, threw herself away at a frantic run, then reversed herself to kick the nearest bit of convulsing alien before

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stumbling out of the pouring water.

Emmet caught her coming out, and she sagged against him. "You and you plasmaed hunches," she growled. "Well, fellow ex-lungfish, this is one dried-up puddle I vote to pass on, too!"

"All of them, from now on," he growled, his vague unease transmuted to tenacious decision. From now on . . .

Then the two watched with the others, fascinated, as the spread-out monster continued to convulse, humping up and slipping back—and each time, a little less showing through the broth the water was becoming. They kept the flow up, until nothing showed for many stimmets. Then they shut the transmuters off, and watched as the water drained away into ground and atmosphere.

Until there was nothing there but roiled-up, rapidly drying surface.

Domino didn't even get a chance to file her "Pass" recommendation; the captain didn't like surprises. "This was a marginal world, anyway," her voice came through panel speakers. "Too much trouble to terraform, and when you throw in a bag of tricks—let it bake to its heart's content. And it's borderline for automated stripping, too. So let's not waste any more time on it, hums. Pack it in, and we'll try for a better prize in the next system."

No one was sorry to leave; the camp was cleared in record time.

The itchy minds are finally gone, and I can sleep again, until the long drought is over. Life-giving water; I can't understand how a source I could carry in my membranes could produce enough water to cover me completely, enough water—barely, but enough—to soften the dried-out ground to mud, so I could burrow down and still have enough fluid to help me make the change again, form another spore. Safely I can sleep, and know I will wake with the others, when the great revival comes.

Odd, there is nothing in my memory, or in any of my inherited or bestowed templates, about strange drought mirages that make your mind itch. Perhaps one of the older ones, who has been through many long droughts instead of my mere two, can explain it. But I don't think so. I think the itchy mirages and the miracle water will spark interesting discussions through many a lush cycle. Perhaps I can even make Pansophist Grade IV on the strength of my contribution. I don't care why the water came, though; really, I'm just grateful it did. I'm too young to die.

> . . . Certain species of Terrestrial lungfishes have the capability of forming a mud and mucous sphere around themselves during dry periods. This shell can dry to a protective hardness; thus encased, they can survive amazingly long drought periods, losing only a small fraction of their bulk, which is quickly recovered upon emergence.

2) Order . . . ■

● ...we are not to imagine or suppose, but to *discover*, what nature does or may be made to do.

Sir Francis Bacon

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Probability Zero

ESCAPE VELOCITY

Don Sakers

"You're certain?"

"Gentlebeings of the press, there is no doubt. We've checked independently with both our large computers, Aristarchus and Kidenas. I'd better let them tell you."

"Charon Observatory has detected increased radiation from Sagittarius. The center of our galaxy exploded centuries ago. Radiation is now reaching us, and soon will make Earth uninhabitable."

"How soon?"

"Twelve hundred years. The last ships of the evacuation fleet should be launched within the millennium."

"Evacuation fleet?"

"Yes. We will move the solar system's population to the Andromeda Galaxy. Our test probe leaves in three months."

It'll never work, Kidenas said.

It has to. The new gravitic drive can accelerate the ship to any fraction of lightspeed. They'll reach Andromeda after only a few years' subjective. The ship

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presents minimum cross-section to interstellar medium—it's only twelve meters across at the widest.

And six hundred long; I know. The parameters are unassailable, Aristarchus. I still have a horrible feeling it won't work. We ought to explore other options.

Nevertheless, Probe One left on schedule. Aristarchus and Kidenas watched its velocity climb. After a few years it was 99% lightspeed, then 99.9%, then the nines multiplied under the tireless gravitic drive.

Only the computers could think quickly enough to catch the probe's messages—and after a century, even they couldn't keep up with the time contraction.

We'll hear from them in a few hundred thousand years when they decelerate for final approach, Aristarchus said. *Let's get the fleet going.*

Kidenas had to agree . . . yet he couldn't shake his dread.

Eight hundred years later Probe Four Billion Eighteen left carrying the last humans, and Aristarchus and Kidenas sat back to contemplate an empty solar system.

Probe One velocity is ten-exponent-minus-47 percent short of lightspeed, Aristarchus reported gleefully. Such minor variations had long since passed beyond the sensing capability of their most delicate instruments, but they could still be calculated.

Right, Kidenas answered. *And her mass is larger than Jupiter's, her length a minor fraction of a centimeter.*

Do you still doubt that the fleet was a good idea?

Doesn't matter. We can't contact the probes anyhow. And yet . . .

Kidenas threw some figures, didn't like the answer, threw some more. *Oh God. What?*

More massive than three Jupiters. Infinitesimally flat. And twelve meters in cross-sectional diameter.

Damn.

Aristarchus, they're within their own Schwarzchild radius!

Over the next thousand years, as Earth became steadily more uninhabitable, the two computers watched in horror as, one at a time, the ships of the evacuation fleet turned into black holes. . . . ■

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The Alternate View

THE NEXT SHORTAGE

G. Harry Stine

Shortage: an artificial scarcity of a product or service created by a ruler or politician utilizing the news media to force you to give him what you posses of the scarce item so he can then (a) give a little bit of it back to you; (b) tell you what you can do with what little you've been given; (c) control its distribution to others; (d) tax it or otherwise control or manipulate the price for his benefit; and (e) consolidate his power by insuring that his friends manage to get as much of the scarce item as they want.

In retrospect, the '70s might be called the Decade of Shortages.

It started out with the limits-to-growth philosophy, which implied a shortage of *everything*. Only a few people such as Dr. J. Peter Vajk bothered to check the world model developed by J. Forrester and used by Meadows and his colleagues in developing their world of scarcity. Dr. Herman Kahn also pointed out where Meadows and the limits-to-growth people were wrong. The news media *loved* the limits to growth, and it was difficult for the Loyal Opposition to get a word in edgewise. But shortly thereafter it didn't make any difference anyway, because an artifical shortage was created in real time.

The worry about future shortages stopped in 1973 because the news media revealed to the world that there was an "Energy Crisis" and proved it by showing pictures of long lines of automobiles waiting to buy gasoline.

Again, a lot of people—myself included—said this was nonsense, that there was plenty of energy, and that this was nothing more than the good old Attila racket at work in the modern world. The data on petroleum reserves was solid and showed enough petroleum in *proven reserves* to last well into the 21st century.

OPEC couldn't last. It didn't. OPEC knew it, too. They therefore made as much money as they could as fast as they could and managed to get it stashed away in Swiss bank accounts before the current "world oil glut" slapped them down. It's a moot point whether or not oil prices would have increased anyway because of the removal of artificial government-imposed price lids. Petroleum products right now are selling at just about the right price in terms of inflated dollars.

The "Energy Crisis" caused a lot of people to spend a lot of money on wood stoves, solar water heaters, and economy cars.

Wood-burning stoves are *not* the long-range answer to heating dwellings. Reasons: (a) the available wood gets burned much faster than it can be grown; (b) the environmentalists are going to catch on to the fact that burning wood for fuel is going to strip the forests quicker than lumbering or papermaking would; (c) wood-burning heaters are

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already causing an air pollution problem even in rural areas; and (d) Harvard University researchers have come to the obvious and inevitable conclusion that wood smoke is carcinogenic.

(Question: If wood smoke causes cancer and genetic damage, why didn't all our ancestors who lived in smoke-filled caves and hovels die of cancer or produce malformed children? How did the human race survive a million years of living in a polluted world?)

Solar energy wasn't and isn't the answer, either. I ran the numbers and discovered I'd be better off continuing to heat with natural gas because doing so would cost me *less* than the interest payments on the loan for the solar energy system.

A similar bout with the numbers told me I shouldn't sell a car that runs on regular gas, gets 14 miles to the gallon, has the minimum annual license fee, costs little to insure, and is paid for, just so I can achieve 25 mpg with a smaller car that won't carry as much, requires more expensive lead-free fuel, and costs more for license, insurance, and interest. I figured I'd have to drive more than 20,000 miles per year to make a 10-mpg difference pay for itself.

The answer: Hang tight and ride the "energy crisis" through, then get ready for the next "shortage."

It's here. It's the "Water Shortage." Suddenly there isn't enough water anymore. Everybody *must* conserve now. If you've got any good ideas for water-saving products, now's the time to get them on the market!

However, the media hasn't mentioned that rainfall is reasonably normal nearly everywhere, that there's a good snow pack on the mountains to feed the aquifers, and that there've been floods and other water-caused disasters here and there. I live in an artificial oasis in Arizona's Sonoran Desert. The reservoirs are full. But the politicans are yelling for water rationing anyway. At the same time, they granted a building permit for an 18-hole championship PGA golf course uphill from all the irrigation canals, but nobody bothered to ask how they intended to grow a golf course in the desert in the midst of a water shortage. Thus far, they haven't been hoist by their petard, but some bright individual will manage to break through the media barrier and throw something in the fan.

Forecast of the *next* shortage: In the latter part of this decade, there will be a "Food Shortage."

Food prices will suddenly go out of sight. Meat prices will become astronomical because "experts" will point out that an animal is an extremely inefficient way of producing protein and that we should therefore become vegetarians to conserve scarce food. (I have nothing against vegetarians, mind you. Eat what you want. But don't tell me what I *must* eat!)

Food prices are very likely to increase in this decade anyway because American food is now underpriced. Americans spend only 13% of their income on food. In most developed countries, people spend about 25% of their paychecks on food. In underdeveloped countries it can be as much as 50% to 80%.

But the hue and cry from "food experts" will arise because they'll claim that raising animals for food is wasteful of natural resources.

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This is as ridiculous as the Highway Patrol issuing citations for "wasting natural resources" to those drivers caught exceeding the 55-mph speed limit. Yes, it's being done in some states where the legislature in its wisdom has decreed that "wasting natural resources" is a misdemeanor punishable by a $25 fine.

And most people, including the news media, will fall for this "wasting natural resources" campaign because they don't realize that 47% of the world's land is rangeland. Nothing can grow there except forage which is unfit for human consumption but which grazing animals can readily convert into high-energy protein. In American commercial beef operations, only 20% of an animal's market weight is produced by grain feeding during the final months of fattening, and animals can be brought to the final fattening stage within only 14 to 17 months of life, grazing on the open range. Poultry and swine are more efficient converters and grow faster, but they can't forage on rangelands and must be fed only grain.

The primary weapon of the politicians and news media in coercing the public to accept the "reality" of the "food shortage" will be the 500 million people in the world who suffer from malnutrition or are starving to death. So we must "share" with them.

But food production and nutrition vary considerably from country to country and in many places are tied intimately to religious and traditional cultural patterns. Although many nations can't produce enough to feed their own populations, they're beyond help from the outside because they're not willing to give up their traditional ways. It's not physically or financially possible for the outside world to support their ways.

Food shipments are a poor answer to hunger even today. They merely serve to subsidize a system that isn't working and *can't* work in the current cultural systems of those countries.

But there's an answer, and we've got it right over our heads.

We have the technology to produce more than enough food for everybody. The knowledge required to solve the problem is in hand. But people must be motivated to use it.

With direct broadcast communications satellites, we can reach right into the villages of underdeveloped countries to bring them the knowledge they must have to survive. We've already done it with ATS-3 in India.

Hunger is a strong motivator, particularly when the hungry people realize that Big Daddy isn't going to bail them out. If we subsidize them with products, we'll only prolong the problem. When we have to stop the aid because we can't afford it any longer, those who received it will hate us both for stopping it and for fostering their dependence upon us. Dependence always breeds resentment.

The long-term solution to the coming "food crisis" and *every other shortage* is knowledge, here and everywhere.

If we really care about our fellow human beings, we must provide them with knowledge. When we do that, we promote independence and self-esteem. We have the knowledge, and we have the means for worldwide dissemination of that knowledge—which can lead only to the realization that this is, after all, a world of plenty if people will set their minds toward making it that way. ■

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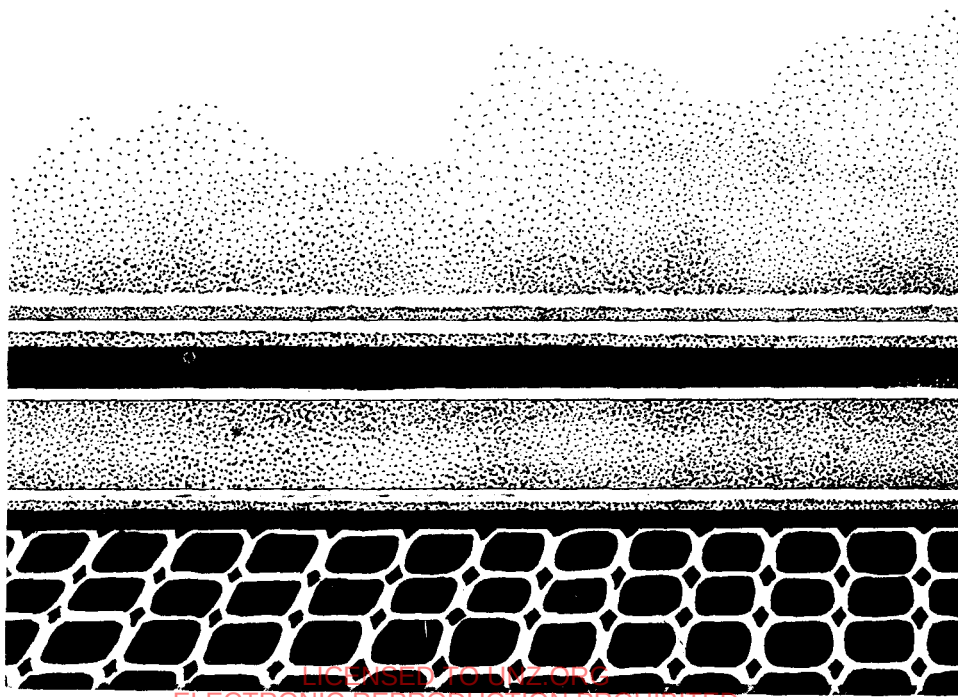
MY BROTHER'S KEEPER

Joseph H. Delaney

When you're stuck with a new system, you can grumble about it, fight it, or learn to use it.



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Weyland Smith awoke, stretched, scratched his ribs with both hands, then sat bolt upright and jumped out of bed. The clock on the dresser said 8:35—three quarters of an hour past his usual time for rising. "Must have forgetten to set the alarm again."

He took a closer look, noticed a low, harsh buzzing sound, and saw that the button was down. Broken! Cheap Romanian junk: you couldn't trust it to work once it was out of the store.

He rushed over to the window and looked out across the road through the sunny, clear December morning, toward the plant. There were cars in the parking lot, among them Sam Solis's battered pickup truck. He relaxed; with his foreman on the job there was nothing to worry about. Sam knew where to find him if there were any problems, and he'd have the line going smoothly in a few minutes.

Smith went to the kitchen, yanked open the freezer and extracted a type 22-B breakfast; one of his own, of course. He knew what was in his stuff. Other brands were mysteries. He popped the package into his microwave, set the timer, then stepped into the grooming cupboard for a shower and a shave. By the time he was dry and dressed the food had cooled enough to eat. Because it was already late, he decided to take it to the office.

Across the road he went, carrying the food on a tray. It was going to be a warm one, he thought; a real nice South Texas day. There'd been a casualty the night before. Smith stepped over the fallen sign, mud spattered and crushed. He could still read it, of course; "Entering Taft—friendliest cotton-picking town in Texas."

Might have been once, he thought, years ago. Some people still grew cotton, of course, since natural fiber was still used, but mostly people wore things made from minerals: synthetics, that came down from the orbital factories in huge winged pods in never-ending supply. Synthetics with which Earth-based producers couldn't compete because they had to pay for their power and their material. Even Texas had to do that now that the oil and gas had run out.

Food was different. Earth still had the edge, for a while. How much longer that would last nobody knew, but Smith could remember how things had been thirty years ago when he was a boy. People still ran cattle then, and grew milo to feed them. You could get really good meat. That stopped when the flood of reasonably cheap fertilizers, derived from petroleum, had dwindled away, and now most people ate from tanks, like those behind his own small factory.

The tanks were supplied from a railroad spur now. In a few months that would change, when the pipeline from Clar-Del's big reactor was finished. Then the protein-rich slurry would flow directly into his own system, where it would be flavored, textured, and shaped to roughly resemble the natural products of a couple of generations ago.

Clar-Del could very well have done that themselves, and Smith sometimes wondered why they didn't. But Clar-Del's president, Delmar Schoonover, was an oddball. Whatever his reasons for permitting small jobbers like Smith to make a living, Smith was grateful.

Smith walked up the stairs to his bal-

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cony office, which overlooked the plant. Sam was standing before the monitor, clipboard in hand, checking the line's flow. He looked up and waved. Smith waved back, then entered his office, set the food down on his desk, and began eating. Yuk—the stuff tasted worse every day. He nevertheless ate half of it before dumping the rest in the disposer.

That wasn't a very patriotic thing to do, but then Smith wasn't feeling very patriotic at the moment. Well, now to work.

He punched the "on" button on his desk terminal and swung the reader over from the wall. It moved easily on its swivel arm and its screen lit up an inoffensive yellow-green. Almost absentmindedly he started the message sequence. Mostly it was routine stuff: bills, which he shunted off to one or the other of his accounting codes; promotional messages, which told him tersely why he couldn't get along without this or that product, or this or that machine. He hated to read the mail, but it was his first job of the day, every day.

There was a "personal" message from Senator Ortiz, which explained in great detail how necessary he was to the government and how urgent it was that Smith vote to re-elect him. Smith found himself relegating most of the similar mail to "delete from memory."

Hold it—what's this? "Dear Taxpayer," it said. He looked up at the letterhead. It was from the San Patricio County Collector. His eyes dropped to the body.

"Effective January 1, 2019 your rate will be reduced to $00.22 per $100 of assessed valuation. Please note your records accordingly. If you disagree with this action you may appeal the same by . . . "

Disagree! Wow—nobody'd be that crazy. This represented almost a fifty-percent reduction. It had to be some kind of mistake. Smith activated his phone, punched up the county courthouse, and asked for the collector's office.

A middle-aged woman's face appeared on the screen. Her name tag identified her as Vickie Garza. "Can I help you?"

"This is Weyland Smith of Smith Nutrionics, in Taft. I got a notice about a tax reduction. That has to be a mistake and I don't want to get behind and have to cough up later."

"What's the account number?"

Smith gave it to her, confident she'd check it out and tell him it was a computer error. He waited long moments, until she finally reappeared.

"There's no mistake, Mr. Smith. The rate is now oh-point two-two."

"Thank you, Miss Garza." Smith broke the connection. Well, now, this was all right. With that other .23 cents per hundred he and his fourteen employees could have a raise. This called for a celebration. He went to the coffee maker, ground a couple of ounces of his small hoard of real Columbian coffee beans, and brewed himself a cup of really good coffee. The rest of the day he'd have to be satisfied with the awful-tasting ersatz stuff.

Back to work. He reactivated the message sequence and let it roll, sipping coffee and diverting the display, item by item. There were a surprisingly large number of new orders, which he routed

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down to Sam's terminal to be filled. He felt even better then; business looked pretty good today.

But in every paradise there is a serpent. And the serpent reared its ugly head in the form of a letter which seemed to be all address: it filled the entire screen. And Smith's blood ran cold at the first four words:

"United States of America," it said. Any letter that started that way was trouble.

His eyes dipped to the next line. Office of the Secretary, Department of Welfare, Indigent Citizen Rehabilitation and Subsistence Division—it went on and on. Now Smith was really scared.

He punched the advance button. Immediately the rest of the page began printing out. It had all the earmarks of a form letter, and they were the worst kind to get from the government.

Dear Citizen:

House Bill 1839 (Social Responsibility Act) has been enacted into law effective January 1, 2019, as Title 42, Section 9056 U.S. Code.

The records of this department indicate that you may be required to register for participation in the program covered by this statute.

You are, therefore, directed to appear for registration at 9:00 A.M. Friday, December 20, 2019 in Room 555, Federal Building, 1100 North Mesquite Street, Corpus Christi, Texas.

Failure to appear and register as directed has been designated as a felony under the above statute.

Very truly yours,
Israel Goltzman,
Section Chief

Smith Fumed. First good news—then bad news, and all of it mysterious. He punched up the operator. "Get me the number of the U.S. Department of Welfare in Corpus Christi."

The number appeared on the screen almost instantly. He punched it in. The government operator answered.

"I want to speak to Mr. Goltzman."

"I'm sorry, sir. Mr. Goltzman is not taking calls."

"Is he in?"

"I have no way of knowing that, sir, nor would I be permitted to give you that information."

"Look, operator, I received a notice from him this morning to come there and . . . "

"A notice to register?"

"Yes, I . . . "

"This office is not handling registration enquiries. I can give you a number in Houston."

"Let me have it."

She did. Smith almost called, then changed his mind. Why should he bother; he was paying Hector DePena a fat retainer to handle that kind of stuff. He punched out Hector's number. Rachel Gonzalez's face appeared on screen. She recognized him immediately.

"Mr. Smith, good morning."

"Hi, Rachel—I need to talk to Hector right away. It he in?"

"No, as a matter of fact he isn't, and won't be all day. But if it's real important I think I can reach him."

"Then do it, Rachel. I got a strange letter from the government this morning—something about registration."

"Oh, yeah. Well, yes; I think I'd better put you through to Mr. DePena then. Could he call you? It might take a while."

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"Yes. But make it as quick as you can. It sounded bad."

"It is. Stand by your phone, Mr. Smith." She hung up.

This time Smith poured himself not coffee, but whiskey: three fingers of it. And he'd gulped most of it down when his phone chimed.

His screen was blank, but Hector called to him. "Weyland, I'm out in the boat; no video. Rachel says you got a notice to register."

"It came this morning, Hector. What's it all about? They wouldn't tell me anything at the Federal Building."

"It's a new welfare program, Weyland. Surely you heard about it on the news?"

"I hear lots of stuff on the news, most of it useless crap. I don't pay that much attention. Anyhow, I don't have any labor problems. All my people have been with me since I took over the business."

"It's not that, Weyland. Look, we'd better meet; your place or mine, about noon. OK?"

"Make it lunch—over at the Loose Caboose. The rumor is they just got a shipment of Australian steaks."

"Fine. I'll meet you there."

Weyland was waiting when Hector drove up in a flashy new Mallory sports car. The thing looked powerful, with its tiny passenger compartment and long hood. It must be about three-quarters coils. Hector was still in his fishing clothes.

"Are they biting?"

"If they were I wouldn't be here. Did you bring a printout?"

"No. I didn't think of it."

"No matter. Ive seen quite a few already. I can almost tell you what it said."

"I already know that, Hector. What does it mean?"

They were interrupted by a waitress, who took their order and brought them complimentary drinks. Hector took a sip of his and said gravely, "Welcome to the ranks of the affluent, Weyland."

"Huh? Hector, I know you got the meter running and I'll get a bill for this, maybe for the dinner, too; so get with it, will you? I want answers."

"I don't like to give people bad news, Weyland. It's my Spanish blood. But you're right: you need answers. Maybe you got a problem, maybe you don't. Do you expect to make more than $175,000 this year?"

"No—uh, wait a minute. I got a tax reduction notice today, too. Maybe I will, barely. Why?"

"Because that's the cut-off point. Below that, you're probably safe, at least for now. Above that, you're considered affluent, which means you have to start sharing your good fortune with people who aren't."

"Huh!"

"Nothing's really changed, Weyland. The system's just been shifted around to work a little different, that's all. Do you know why your county taxes dropped?"

"No, and I thought that was a little odd, too. Why?"

"Because the new federal system is supposed to replace a lot of the state assistance programs. Everything goes into effect the first of the year."

"I don't see what that's got to do with me."

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"You don't, huh. Well, I'll tell you: just like always, the people who have are going to be taking care of the people who have not. It's as old as man."

Smith looked at Hector, still puzzled, and said, "Some new kind of tax?"

"Not exactly. Look, Weyland, I think I better give you a history lesson, OK? That's the only way you'll ever really understand it. And I want you to listen."

Smith nodded and finished his drink. Hector looked like a bum in his fishing clothes and two-day beard, but he'd listen.

"There have always been people in every society who couldn't make it, Weyland. Those who got old, were disabled, were sick or just plain dumb. Sometimes people had a bad run of luck: a poor crop, or a flood, or fire or some other disaster. Society took on the responsibility of looking after them.

"In this country, up until the great depression, that's the way it was: pretty much a private, voluntary thing, except for minor involvement by local government. It was workable then, too, because control stayed in the community and it was a pretty difficult thing to pull anything crooked on people who really knew you.

"Then Uncle got involved. Somebody in Congress got a fine, noble idea, figured it'd be nice if the old folks had something to fall back on when they got along toward the end of the road. And the Social Security Act came into being. Nice and simple, too; everybody who paid in got to take out when their time came. Actuaries figured out what the contributions had to be and what benefits could be paid. For about twenty years it worked fine. Then in 1958 they changed it.

"The change involved disabled workers over fifty. Somebody thought it'd be nice if disabled people who couldn't contribute any more could get their eligibility frozen and not lose benefits when they attained age 65. The system still worked fine. So well, in fact, that the interest on the trust fund could be used to increase benefits. They used the principal to make payments on other government obligations so that it could produce that income. The system stayed solvent.

"It stayed solvent even when they started giving disabled people pensions at age 50. It stayed solvent even when they eliminated the age requirement, but it started to shake a little.

"Then somebody got another fine, noble idea: how about all those poor people who weren't eligible for pensions, either because they hadn't paid in at all, or hadn't paid enough? They had rights, too, didn't they? And here was this tremendously solvent fund just waiting to be tapped.

"That started it. That and political rewards Congress could gain by giving all these voters something they wanted. Sure, they had to up the assessments to pay for it, but only a little.

"Of course, it didn't stay that way. The inevitable happened. Built-in increases in benefits were tied to the cost of living, which went up, so rates started a spiral. Even so, the system couldn't keep up, and as you know, finally went broke in 1987.

"And again, it wasn't the only social program affected, or the only one to get in trouble. We had straight welfare too;

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big impersonal welfare, where faceless people drew benefits from faceless government through faceless bureaucrats. You had outright grants, food stamps, monthly cash assistance checks, medical care and assistance programs, legal care assistance programs. The list was endless, the regulations voluminous and the abuse massive.

"You paid for it; I paid for it. And nobody knew who was getting how much, or why, or whether it was doing any good. And it became so expensive that only general revenues could handle it; the self-funding trust was broke.

"Then there were the population booms. We had one in the Sixties, and for a while this helped. It supplied more contributors and kept the system going for a while despite the overloading. Then the birthrate dropped, for reasons I won't go into, and the contributors got old and became beneficiaries instead.

"Still, Uncle plodded along. He managed to get through the Nineties without too much trouble, because the American taxpayer was hardworking, honest, and stoic. Then in 2009 he got another break. Thanks largely to the fact the West finally got smart and fought the communists with their really effective weapon: money.

"They broke the Soviet bloc economically and it collapsed. All the funds we'd previously had to pour into armaments went into social programs instead. And as the dominant power on this planet, we thought we had it made.

"Well, we didn't. All those East European countries are busy dumping cheap textiles and consumer goods into our markets. And the old standbys —steel, fiber, electronics, all the really high-technology and big-money stuff? It's in space, where Uncle can't really tax it because of some stupid treaties we made in the Fifties when the Soviets were leading the space race."

Lunch arrived. Smith was grateful that Hector finally shut up.

But Hector demolished his steak in record time, ordered coffee, and went on.

"Now, what have we got to work with? We've got three hundred ten million people, officially, plus who-knows-how-many illegals, and jobs for less than half of them. We're energy-poor. Our farmland's worn out, and if it wasn't for synthetics we'd all starve. So now our social problems are bigger than ever, but we have gotten a little smarter.

"For one thing, Uncle bailed out, back in 2011, and handed the mess back to the states. The federal people knew they'd lost control and hoped the states could do better. And the states tried hard. They got it going in the right direction, toward local control.

"However, they lost uniformity, and that resulted in shopping. The sun belt states got hit the hardest, because we had a pleasant climate, as well as generally better economies. Texas was the worst off, since we have the largest spaceport in the world and handle ninety percent of the world's imports from orbit. People flocked here in droves.

"The states complained; got on Uncle's back to try again, and Uncle's doing it. That's why your taxes went down, Weyland, and why you might have to register."

"Hector, I appreciate the lecture. You should have been a teacher.

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But—when are you going to get to the point?''

''Why now, Weyland. I thought it was important you understand it all the way through. Actually, the idea sounds simple enough: from now on welfare is going to be a personal thing—from the haves to the have-nots, eyeball to eyeball.''

''Hector!''

''You got it, Weyland. If you meet the income requirements you'll have to register. Then you get to pick your new dependents out of the pool. They've already got a name for it: Lords and Peasants.''

''You're serious, aren't you, Hector? You're not kidding?''

''I'm not kidding. You'll have to support at least one person, maybe two, and give him basic subsistence. The laws also requires you to attempt re-education and rehabilitation, so that your ward can get a job and get off the program.''

''What happens if he does get off?''

''You get a replacement.''

''You mean I'm stuck for life.''

''That depends. There are ways to get out of it: if you go broke, or gain legitimate dependents after a five-year wait, of course; that's to stop quickie marriages and stuff.''

''This is insane, Hector. It can't work. Besides, it has to be illegal. Can't you do something?''

''It's already under attack on constitutional grounds, Weyland, but the smart money's betting it'll wash. Don't forget, the Supreme Court has tortured the Constitution way out of shape for years to validate what they think is good social legislation.

''And anyhow, it's not all that crazy. Some of the best minds in the country favor it. They think this system can avoid the abuses that broke the others, and maybe they're right. At least the donors are going to have a powerful incentive to keep track of things. If your ward tries to cheat you and you catch him at it, he's had it.''

''Do I get out if that happens?''

''No. But you get a new ward.''

''What happens if I don't register, or if I don't pick anybody?''

''Well, in the first instance you'll be prosecuted; penalty's five years and fifty thousand, or both. In the second they'll simply assign someone to you and you won't have a thing to say about who it'll be. Of course, you might not really be subject to the act. There's always a chance for that. I'm not worried.''

''Hey, wait a mintue, Hector. How about you? You've got to be dragging down at least as much as I am.''

''Yeah, but I'm smarter'n you, Weyland. I got my own dependents, a wife and four kids. My hands are already full. I gotta go, Weyland. Call me after your interview.''

Weyland watched him wheel out of the parking lot, dumping kilowatts into his drive motor, squealing the wheels. He looked up to the smiling waitress holding their check. ''Hector was right,'' he said to himself. ''He is smarter than me.''

On the 20th Weyland appeared at the federal building for his interview. There was a long line and he wasted the entire morning. When he finally did get in, a huffy, pimply-faced young man reviewed the records on the screen and

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grunted. He didn't even introduce himself.

"Looks like you'll make it, Mr. Smith. You're just in there, though."

"But I already have fourteen employees I support. Isn't that enough?"

"Doesn't matter. Eligibility is figured on your adjusted gross income, before taxes. That's high enough for you to qualify."

"Why before taxes? Surely you people realize I get socked for a bundle already."

"We take that into consideration, Mr. Smith. You get a deduction for your ward; either the standard percentage or your actual cost, whichever is greater. We aren't heartless."

Weyland could have argued there, but he didn't. Instead he said. "Is that all you want?"

"Yes, for the time being. I'm going to classify you as eligible. Here's a list of wards scheduled to be in the first pool January 6. On the back you'll find the text of the statute and an explanation of your legal rights, including the right to appeal this classification. You might want to have your lawyer look at it."

"Yeah, I might." Weyland left and went straight to Hector's office. Rachel was off sick, so Hector didn't have any insulation. Smith barged right in on him.

"Eligible, Hector. I'm stuck unless you can think of a way out."

"You're stuck even if I can. We could appeal the classification, but you'd still have to comply."

"Do it, Hector." He threw the list on Hector's desk.

"Right, boss. Only don't you want the list? You might do better picking on your own."

"How? They're all losers. If I'm going to get stuck anyhow what difference does it make? Just you fix it so it's not for life."

"I'll do what I can, Weyland, but I'm not a magician. I have to work with the tools the law gives me. Your appeal notice will get filed today even if I have to type it myself."

"One more thing, Hector. I already paid for your steak lunch; what's it doing on your bill as an expense?"

"Oversight, Weyland. I'll fix it. Don't worry about a thing."

Time passed. January 6 came und went, and Weyland heard nothing from either Hector or the IRSD. He felt pretty good about that; no news was good news. Maybe Hector had found him a loophole.

Smith went on about his work. The orders poured in faster than ever and the plant was running smoothly. Thanks to the tax break, all fourteen employees were enjoying a five-percent raise and Weyland was looking at a new Mallory sports car like the one Hector had. Finally, when nothing happened by February 3, he went ahead and bought it.

Next day, just after lunch, Sam came running into his office. Weyland looked up, startled, from his work on the new dessert blends he was thinking of putting out. "What's wrong, Sam?"

"It's your new car, boss. Somebody's been fooling with it. Gus and Davey got him, though; caught him redhanded. They locked him in the freezer downstairs."

Smith jumped up and followed Sam

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downstairs, where a loud thumping could be heard over the noise of the machinery. "Open the door, Sam."

Flanked by the other three, Sam unlatched the door and pulled it open.

"It's about time," yelled the stringy-haired youth who stood there, shivering. "You can't do this to me; I know my rights."

"As far as I'm concerned, whoever messes with my new car hasn't got any rights. Go call the law, Sam." Smith as burning. The thought of this creep stealing his car made his blood boil.

The youth struggled to free one arm, then reached inside his shirt and pulled out a soggy, dog-eared envelope. "It says here you gotta take care of me. You are Weyland Smith, ain'tcha?"

Smith took the proffered envelope, holding it gingerly with two fingers of his left hand, while with his right he fished out the equally soggy one-page letter. The paper stuck together where it was folded, but he shook it open.

It was addressed to John Wayne Evans, reference W-109-33-IRSD-1-78336.

Dear Mr. Evans:

Pursuant to the provisions of the Social Responsibility Act, Title 42, Sec 9056, Et Seq., U.S.C., you have been assigned to the following named Guardian:

Weyland Smith
Ref G-112-98 IRDS-1-78336

You are directed to report to said Guardian no later than 1700 hours, February 4, 2020. Severe penalties are imposed for failure to comply.

If you disagree with this ruling you may seek administrative review (see reverse), however, the filing of an application for review does not operate to relieve you of the responsibility to report as ordered.

Sincerely,
I. Goltzman, Section Chief

Weyland finished reading the letter and looked up. His ward was smirking. "How about telling these creeps to let go of me."

"Turn him loose. But you stay put, you hear?"

The youth nodded, but kept his smirk.

"What am I supposed to do with you?"

"Don't you know?"

"No. I didn't even know you were coming. But then, I haven't gotten around to the mail today. Tell you what: go with my foreman. Sam, find something for him to do, and Sam, make that inside the plant. If he even looks at my car I want to see blood all over him."

"Right, boss." Sam gave the kid a nudge toward the line and the other followed.

Weyland went upstairs, started the mail sequence, and shunted everything to printout. When the computer finally stopped printing, he waded through the pile until he found his own notice. It was different, much longer. And it spelled out exactly what both he and the ward were expected to do for one another. For instance, Weyland had to provide food, shelter, clothing, and discipline (within limits) and in return he had the right to services, obedience, and any earnings the ward might have.

Housing was going to be a problem, he realized. Right now, there didn't seem to be any alternative but to put the kid up in his own quarters, and Weyland

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found that idea repugnant. He was warned, though, that failure to exercise control over the ward's activities might subject him to liability for any damage he might do. So he decided to give it a try and run as tight a ship as he could. During the day, of course, he'd have Sam and the guys to help with that, and he felt confident they could handle things.

Trouble started that night. Right after supper the kid took his bindle and camped in Weyland's spare room. Weyland spent much of the early evening at his terminal, running simulations of the new dessert lines, and stayed fairly busy. Gradually, however, he became aware of a strange aromatic smell coming from behind him.

He turned around and immediately noticed the door was now closed. It was strangely quiet, too. Curious, he carefully turned the knob and eased the door open a crack. Inside it was dark, but the odor was now overpowering. He was getting lightheaded from it.

He closed the door and ran to the nearest window, throwing it open and taking deep, head-clearing breaths. Then he opened every other window in his quarters.

The odor fled before the stiff southeast breeze and he now felt safe opening the door again. In the dark was a glow, which looked like the end of a cigar. He snapped on the light, to discover the kid in the lotus position on the floor. Beneath his head was a saucer on which smouldered a pile of greenish powder. He recognized it instantly: spaceweed.

Spaceweed was a particularly potent strain of cannabis, developed and surreptitiously grown in orbit, where controlled conditions made the most of its intoxicating propensity.

Weyland picked up the saucer and dumped its contents into the nearby john, after which he opened the window wide. Evans sat there, blankly staring ahead, seeming not to notice what was going on. Weyland searched the bindle, found a plastic bag with about half a pound of the stuff in it, and dumped it and several loose red pills likewise into the john.

Through it all the kid sat. He couldn't be more than 19, Smith thought, but obviously that was old enough to be a doper. He wondered what else there was to know about his ward that might interest him. Maybe he ought to turn the kid in to the police.

No, he thought, getting them involved might result in a prosecution for possession, and the rules said defense of criminal charges were his responsibility anyhow. Better to handle it himself. It was cheaper.

He went into the kitchen, found his hammer and a couple of nails. Closing the window, he drove one through the sash on each side. This done, he locked the door from the outside, leaving the kid on the floor.

"He does what I tell him, boss. Seems to be smart enough for that. But that's all he does; not a lick of extra work. And he takes his time doing it."

"Keep on him, Sam."

Weyland turned on his heel and marched up the stairs to his office. He truly couldn't comprehend the modern generation. It just didn't have the drive, the sense of responsibility his had had.

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He thought about the scene earlier that morning when he'd unlocked the door. The kid had been stretched out on the floor, sleeping soundly, until Weyland put a foot in his ribs. Then the kid woke, turned over, and got up. And he hadn't said a word to Smith about the night before. He didn't even indicate he knew his drugs were gone, although his bindle lay open on the floor beside him.

Weyland had heard the grooming cabinet gurgle briefly, but not long enough to do the kid's appearance any real good. He came out and ate silently, and then obediently followed Weyland across the street.

He decided to give Hector a call on the phone and see how his appeal was going.

"It takes time, Weyland. They've got lots of them, and you just have to wait your turn. I take it you're not real satisfied with your assigned ward."

"He's a doper. At least until last night, when I got rid of his stash. I mean, I think I got rid of it. Tell me, Hector, just how far can I go toward restraining him?"

"Nobody really knows the answer to that, Weyland. We'll have to wait until some precedent builds up. Offhand, I'll say you can probably get away with treating him like a pre-teener: reasonable restraint but nothing harmful or degrading. Leg irons are out; so are handcuffs, but you're within your rights to lock the door. How does he do in the daytime?"

"OK, according to Sam. Doesn't work very hard, but he hasn't caused any trouble yet and I . . . wait a minute, Hector."

Silence, except for the shouts, and these were audible but not understandable. The line was down. Smith momentarily expected Sam to appear at the door. When he didn't, Smith stood up and craned his neck, trying to see over the edge of the balcony. "I'll call you back, Hector." He broke the connection and raced for the door.

Even as he opened it he knew it was big trouble, and he could hear voices speaking Spanish, excited voices. The word "guajolote" popped out of every other sentence, and that was one he knew. "Sam! What's the trouble?"

"Salt, boss. He . . . "—pointing to the kid—"cranked a saline valve wide open. Poisoned about five tons of mix."

"El Guajolote" was standing in a nearby corner, hands in his back pockets, stringy hair hanging in his eyes. He looked up at Weyland. Weyland started down the stairs, taking his time, determined to keep his temper. He reached the kid and stopped right in front of him.

"What about this?"

"He told me to bleed in a little salt, but he didn't tell me how much, so I kept it coming. I was waiting for him to tell me when to stop. It's his fault: Sam's."

"Mr. Solis, to you. Let's hear your side of it, Sam."

"I was at the board like always, boss. I told him to crack the valve; not crank it. He cranked it wide open and ignored me when I told him to close it."

"I didn't hear him say nothing about closing it." The kid gave his head a defiant shake, but the hair still fell back across his face. He obviously didn't expect Weyland to believe him.

Weyland didn't. "How bad is it, Sam?"

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"Bad, boss; we'll have to dump this run into storage and use what we've got to dilute the rest of the run. But the run's not that long, so we'll have a couple of tons of waste, at least."

Weyland mentally added it up: a complete loss of profit for the entire day, maybe two days. "Do the best you can, Sam. Then find another job for John." Turning to the kid, he said, "You and me need to talk. Follow me upstairs."

Up in the office the kid sat pensively on the edge of a plastic chair, while Weyland propped his feet on the corner of the desk and tried to look stern. "Look, kid," he said. "I know you don't like being here. It must be interfering with your fun. But remember, I didn't pick you and I didn't need you to start with."

The kid said nothing.

"What did you do before you came here?"

"Nothing, mostly. There wasn't nothing to do."

"Is that so? You mean you didn't have a job of any kind?"

"Only when I was in jail."

"What were you in for?"

"You mean, 'fore I came here, or other times?"

"How many times have you been in jail?"

"Oh, well," the kid said, starting to count on his fingers. "A bunch of times."

Weyland got the impression the kid had run out of fingers. "What for?"

"Stealin', mostly; couple of times for smokin' dope. Nothing big."

"That you got caught at. Look kid, I don't care about your past. All I want you to do is keep out of trouble while you're here. If you do, we'll get along and Sam and the guys'll teach you how to run all the machinery here. You'll have a real job if you behave yourself."

"Makin' that slop! That's a job? I can't stand to look at it, much less eat it. At least while I was on my own I could get real food once in a while. Anyway, that's not the kind of job I'd like."

"It's the kind of job you've got, as long as you're here. Of course, if you can tell me how I can get rid of you . . . "

"Now, wait a minute; you talking about selling me or somethin'?"

"No. In fact, that's sure to be illegal." (Did he detect a slight look of apprehension on the kid's face?) "Anyhow, since you're obviously not ready to work the line, I'm going to have Sam put you on the sanitation crew. Farley's in charge of that, and everybody gets along with him. You do what he tells you and maybe after a while you can try something else. OK?"

"OK—only tell him not to hassle me, huh. I got feelings, too."

Weyland took the kid back downstairs and turned him over to Homer Farley. Farley was a couple bricks shy of a load, but he was good-natured and conscientious. Weyland hoped the kid would appreciate that and learn something from it.

Then he called Hector back. "Little problem with the line, Hector, but we got it worked out. Now, there was something I wanted to ask you. Is there any way to get rid of a ward?"

"Sure, Weyland, all kinds of ways. It's all laid out in the statute."

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"I don't have a copy of the statute; what are they?"

"Well, first of all, you could die, which is kind of extreme, or the ward could die, also extreme. Or you could go bankrupt. Or if the ward commits a crime against you or your property, and you press charges, or if the ward gets a job and becomes self-supporting, or . . . "

"Stop there. Suppose I give my ward a job. Could I terminate him?"

"There's a one-year trial period. Termination would come at the end of that. That's to keep guardians like you from setting up make-work jobs and then canning the ward afterwards. Everything's got a penalty, Weyland."

OK, thought Smith, *that's out. What else is there?* "Hector, could I sell him?"

"Sell your ward? No, of course not. That's slavery. No—wait a minute; you'd be protected from that charge by the statute, since you're just as unwilling as the ward is. Let me check—Hold on a minute." He left the screen for a moment.

Hector came back smiling. "You're right, Weyland—it's not prohibited, at least not yet. I guess there's no reason why you couldn't trade off with somebody if you wanted, provided you could find somebody who was willing. But—you can't get rid of a ward altogether except in the statutory manner. What have you got in mind?"

"Maybe nothing, Hector. Just cooking an idea. Something the kid said. Thanks for your time—see you later."

"I'll put it on your bill, Weyland."

After that, Weyland had a pretty fair day. There was no trouble with John Wayne, who apparently had warmed right up to Homer. That night he stayed in his room out of Weyland's way, watching TV.

Next day and the day after that were repeats, but Weyland wondered if it could possibly last. Tomorrow was Saturday, and the plant wasn't open. He'd be stuck with the kid all weekend.

When the phone rang early Saturday morning and roused Weyland out of a deep sleep, he was hardly prepared to counsel Homer's wife. "Now wait a minute, Pearl; you're talking too fast. Calm down. Tell me slow and easy."

"Homer's in jail. He didn't come home last night and then the police called me and said he was locked up. I don't know what to do."

"What's he supposed to have done, Pearl?"

"Drunk and disorderly, but you know Homer never drank. We been married twenty years and this is the first time he ever stayed out."

By this time Weyland was wide awake and taking a look around. He picked up a hand set, activated it, and walked off camera to the door of the other bedroom. He opened the door, looked in, and saw a curiously motionless lump under the covers. Because of the darkness he couldn't tell for sure, but he'd have bet the ranch the lump wasn't John Wayne Evans.

"Pearl," he said, walking back on camera, "let me call Hector and see if I can get this worked out. Stand by your phone."

"OK," she replied, "and thanks, Mr. Smith. I knew I could count on you."

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Smith broke the connection. The call to Hector could wait; first, the lump. A quick swipe revealed nothing but old towels and blankets bunched up under the covers. No John Wayne Evans. No car either! A glance at the empty parking lot was enough for him to add it up. His new Mallory was gone.

He called Hector and one of the kids answered; a little one who jabbered away in both English and Spanish for long moments before a sleepy Hector rescued him.

"Weyland! What's the matter?"

"Troubles with the kid. And Homer Farley's over at the San Pat County Hotel."

"What about the kid?"

"Gone, Hector, and so's my car. I got a feeling he and Homer went carousing last night and I want you to get Homer out so I can talk to him."

"OK. I can do that. What are you going to do about Evans?"

"I don't know yet, Hector. Listen, can you pick me up when you go after Homer? I haven't got any wheels."

"I'll be there in half an hour."

The San Patricio County Jail was an old four-story building built back in the early Eighties which had long since gone to grime. It was not a place that Weyland visited often, but he had been there before. It had always been a pretty busy place, always full and always depressing.

Today it was different. There was only one deputy at the booking desk, and across the hall Weyland could see Dennis Shay, the sheriff, lounging back in his chair, feet propped on a half-open file drawer, reading a magazine. He had nothing to do while Hector was signing Homer out, so he went over to say hello.

"Hi, Weyland. I guess you're here to spring Homer, huh? I hated to lock him up, but it was a city bust."

"Hector's getting him out now, Dennis. Kind of quiet around here today, isn't it?"

"Things have changed, Weyland. We don't keep anybody very long anymore. Been farming them out lately. It saves the taxpayers a bundle. SRA, you know."

"I thought that was only for individuals."

"Oh, no. We got lots of new rules around here, Weyland. The county's guardian for any prisoner who's got more than thirty days to do. That's the law now, so naturally we don't let them sit around in cells. We work them. Got a few out at my place right now. Still got my farm, you know. Got 'em hoeing jojoba. It wouldn't have paid to plant it, otherwise. How you doing over at the plant?"

"Well, outside of the trouble Homer's in and losing my car, I'm doing OK, I guess."

"You lost your car? How?"

"Ward ran off with it last night."

"Stole it, you mean?"

"I don't know that for sure. I've only had him a week."

"You could be in for a lot of trouble if he hurts somebody with it, Weyland. Did you report it?"

"I haven't had time. Look, Dennis, could we work something out on that, sort of unofficial, you know? Help me find him but hold up on any charges."

The sheriff took his foot down, squared his hat, and looked at Weyland through

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the thick glasses he wore. The lenses made his eyes look monstrous. "I've got no jurisdiction, Weyland, and I can't commit county manpower to a search without a complaint. 'Course, if you were to assure me you'll report it to the city police when you leave here, I'll put it on the air. Chances are, though, he's long gone by now."

"It's a deal, Dennis." He gave the sheriff the descriptions.

Hector appeared in the doorway. Behind him was Homer Farley, looking sheepish and trying to smooth out his wrinkled shirt. He looked awful.

Weyland took him aside. "How'd all this happen, Homer?"

"I don't really know, boss. We was workin' away back at the sludge trap, me and John. I got this headache just afore quittin' time and John Wayne gimme some pills fer it. I took 'em and I don't remember nuthin' else. But m' money's gone. Ever dime. Don't know what I'm gonna tell Pearl."

"Don't worry about it, Homer. I'll talk to her. Everything'll be all right. Come on. We'll take you home." He herded Homer toward the door and Hector started to follow, but just then Dennis called to him.

"Weyland, we got it."

Smith walked back to where Dennis stood, beaming.

"I figured I'd call around first before I put it on the air, Weyland. John Wayne Evans, right? '20 Mallory, red, tag readin' Smith 1? Both of them are over at the constables' lockup at Polecat Creek. The kid blew a stop light and they busted him for DWI: drugs, not liquor. You're gonna have to go down there to get him; 'course, the city boys in Taft'll put a hold on as soon as you report the stolen car."

"Do I have to do that now, Dennis?"

"Not if you don't want to. But be careful; you could wind up losing your car if they found any drugs in it, and if it looks like the kid might have been using it with your permission. That's a pretty nice set of wheels, and somebody might be tempted to try for confiscation."

"I'll talk it over with Hector, Dennis. Thanks for your help."

"My pleasure, Weyland. And listen: get back to me later, after you find out what this is all about. We might be able to work out a deal, OK?"

That remark left Weyland feeling very puzzled, but he was far too upset at the moment to try to figure it out. He followed Hector and Homer out to the car.

Later, after going through all the red tape of reclaiming his car from the constable, he mentioned it to Hector.

"It sounds like Dennis is trying to suggest some kind of trade, Weyland. He's got a pretty good-sized place out there and the stuff he's raising is all labor intensive; stoop labor, like they used to hire my people to do. I've got a hunch Dennis has found a way to get fat off the SRA. And it might be just the way to get you off the hook. Let me work on it a little bit."

Hector did work on it. Monday morning he called Weyland bright and early, all smiles. "You can dump John Wayne if you want to, Weyland. He stole your car, and that's a statutory ground. If you use it, you're then limited in your liability to pay for his defense to the DWI charges, but there's a way around that,

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too. Dennis can work out a deal with his cohort in Nueces County to dismiss that charge and surrender him up here. Then we prosecute, after which Dennis puts him to work on the farm and gives you one of his people in trade."

"He can do that?"

"He seems to think so. Anyway, what have you got to lose?"

"I almost lost my car last time, Hector. But what do you think?

"Does it matter if you're assigned from the pool or make a trade? Either way it's pot luck."

"OK, Hector, we'll go ahead with it. I don't want another John Wayne Evans—I can tell you that."

It took a few days before there was any action, and in the meantime Hector advised that their appeal had been denied by the administrative law judge. They had thirty days to take it up to the District Court for further review. Weyland saw no sense in that and instructed Hector to abandon the case.

Meanwhile he concentrated on getting the plant back to the smooth operational level it had enjoyed before the advent of government assistance.

Friday Hector called him again. "No more John Wayne Evans, Weyland, and Dennis has made you an offer. Not quite what I expected though; it's a three-cornered deal. Dennis has got a little wife trouble. You know Ray Daunt?"

"Who doesn't? Biggest crook in South Texas. What's he got to do with this?"

"Seems Ray's got a couple of old geezers he wants to get rid of. Nobody wants them, though, because they're both over eighty. Somewhere along the line Dennis picked up one Antoinette Dudek, and Ms. Dudek, it seems, has a failing: she has very warm drawers, and apparently no other compensating skills. She's Dennis's own personal ward, and Mrs. Shay is not appreciative. Evidently the deal includes a rather hefty bonus for Dennis, and Ray'll find a use for her, naturally."

Corruption goes on and on, thought Weyland.

"I don't know, Hector. Old people are trouble. They're always sick and you have to baby them. It'd be pure charity."

"What is it now, Weyland? Isn't that the whole idea? Aside from people like Shay and Daunt, who'd find a way to exploit any situation, no guardian is likely to profit by the SRA. But then, on the other hand, the old folks'll spend their nights sleeping instead of carousing around in your car. I'd think twice before saying no if I were you."

Weyland did think about it, and he decided Hector was right. True, under the law he was only obligated to take one ward, considering his earnings category. But under the circumstances he wouldn't spend that much more. He already had a house. He owned the food-processing plant, and old people just didn't need that many clothes to sit around the house. Of course, medical bills could be substantial, but how long could that go on? They'd be living on borrowed time already. He made up his mind to take them.

That next Saturday morning a long black steamer pulled up in front of Weyland's house. The driver got out and opened one of the back doors. An old man jumped out—jumped out like he

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was twenty-five. Bending down, he helped a somewhat more fragile woman from the car.

They stood there while the driver opened the trunk and took out a battered cardboard suitcase. Then the driver walked ahead of them onto the porch and waited.

Weyland left the window from which he'd been watching and opened the door. "Bring that in," he told the driver.

The driver dumped the suitcase in the living room and returned. "This is Mr. and Mrs. Luker," he told Weyland. "That's all the luggage they got." He walked around the old couple and back to the car.

There was something pitiful about all of this, Weyland remembered thinking. Something proud too, in the way the old man helped his wife up the three steps and onto the porch.

The old man was careful with her and bent his head to watch every step she took, as she carefully planted first one and then the other foot firmly. He was thin and wiry, with furrowed, wrinkled skin and white, tightly kinked hair, that judging from his skin coloration had probably once been red.

She too was capped in a snowy white wreath, and her features, though wrinkled as his, were sharp, as if tuned to the stubborn spirit and determination she displayed in ascending the steps.

He gained the summit and waited. She joined him, then looked up, peering through thick lenses set in gold wire frames. "I'm Harry Luker," he said. "And this is Kate, my wife. You're Mr. Smith, I guess."

"Weyland—Weyland Smith," he answered, without managing to match the dignity that burst through in the old man's voice. "Come in, won't you?"

He led the way into his small living room and got the old couple seated on the couch. Better to let them rest a while after that ordeal.

"Kate don't see too well any more," said Harry. "She had cataracts, and the implants didn't take, so she has to wear the glasses. But she gets around all right as long as she goes slow. We'll try not to be any trouble to you."

"I'm sure you won't be, Harry. I'm away a good bit of the time anyway. That's my plant across the street. And this place is automated; not much cleaning to do, and no real cooking. We do that over there."

"I like a kitchen," said Kate. "We always had a real kitchen when Harry and I were young, before all this processed food. I was a farm girl, you know. Grew up over in the Panhandle. We raised wheat and cattle. That's all gone now."

"I know," said Weyland. "I've been there. Nothing but junk crops now. That's all it'll support, but we're lucky to have that, and to be able to process that into food."

He looked at Harry, who sat with his hand on hers. Harry, it seemed, had a better grip on reality than Kate did. He'd probably endured her reminiscences for years.

"We had children," Harry said. "We outlived all of them. Everybody we knew is gone. Grandchildren—they scatter. They go wherever they think they can make a living. Can't blame them for that. We lived at home until

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they cut off our pensions, and then they started this. Mr. Daunt didn't want us."

"Don't worry about it, Harry. You're here. Everything's going to be all right."

But would it be all right? Weyland didn't know. The way the old lady looked at the suitcase, like she might start crying any second. Probably everything she owned was in it; that one tiny battered box. And Harry: Harry was a man who'd learned to swallow pride in old age. You could tell it hurt him to be here, to be dependent and have no choice about it.

After they'd rested a while Weyland moved their suitcase into his spare room, and realized how small it really was. He'd have to remember to draw the nails from the sill so they could open it. Finally he got them settled in, and they seemed to be a little better.

He made excuses to get out of the house; shopping, he said. There were things he had to get before the stores closed. Harry wouldn't be fooled. He would know what Weyland was about, giving them time alone to get their bearings. He was gone for several hours.

When he got back he found Harry in the living room, quietly reading a book from Weyland's technical library. It was a treatise on fermentation processes, a translation from Japanese. Weyland hadn't looked at it in years.

Harry was somewhat abashed at being discovered. "I hope you don't mind, Weyland. Kate's asleep. I needed something to do and I don't like TV."

"No, no, Harry. It's your home now, too. Books are there to read. I'm just a little surprised at your selection. That's pretty dull stuff, and pretty deep, too."

"So I have noticed. Of course," he said, looking at the flyleaf, "I'd been out of school for fifty years when this was written."

"What did you do before, Harry? I mean before you . . . "

"Retired. That's a kind way to put it. I've done lots of things, actually. Started out on a ranch—we didn't own it—my father was a farrier. I learned the smithing craft from him. After that I was a roughneck, out in the Permian. There was a war back in the '60s, so I did some soldiering, too. When I got out, I met Kate. We were both going to U.T., University of Texas, Odessa. I became a petroleum engineer and Kate was a teacher. Taught history. We made a pretty good living for a while, raised our kids; watched them move away and then watched them die off. About the time the oil and gas ran out we retired. Neither one of us wanted to, but we were getting too old. Younger people needed the jobs.

"Then came the depression of '05. That wiped out all my pension and part of hers, and there wasn't any more social security, just welfare. Now that's gone, too. Kate's afraid of this SRA thing. She's a proud woman and all this rushing around has got her bewildered."

Weyland found himself liking Harry already. He was a nice change from the kid. So the old man couldn't be of any use at the plant. So what. He wasn't going to be any trouble either.

He let Harry get back to his reading after that and he, himself, found unfinished paperwork to do, enough to consume the rest of the afternoon.

Dinner was a little awkward. He and

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Harry ate the standard packaged stuff without much comment, but Kate was critical. "I don't mean to sound like an ingrate, Mr. Smith, but it just seems to me that this stuff could taste better. I guess it's because I've lived so long, and I have such vivid memories of how it used to be."

In the days that followed the three of them settled down to an easy routine, and Weyland got used to it. It was as it had been before the news of the system had reached him. He could, and did, go about the business of running the plant while the old folks stayed home and out of the way.

Harry had taken a dive into Weyland's library, both the bound books and the microfilm, and had learned how to use the terminal connected to the big public library downtown. Pretty soon after that he started asking questions about the operation of the plant, questions Weyland couldn't always answer.

So Harry went over for a look. He made friends with Sam and the rest of the crew and asked them questions, too. Mostly, though, he simply watched the others doing their routine work.

Soon Harry was over at the plant every day, all day, almost as though he had a real job again. Weyland left him alone. After all, the old man did no harm. He didn't get in anybody's way or interfere with plant operation, and the crew seemed genuinely content to have him around.

One morning Weyland found Harry waiting for him when he got up. He was sitting at the kitchen table drinking, and apparently enjoying, the synthetic coffee that Weyland disdained.

Weyland greeted him as cheerfully as he could manage, taking into account the early hour, but drew the line at drinking any of the stuff himself.

Harry left the cup empty and put the pot down. "Don't blame you, Weyland. The stuff's awful, but I figure my system's about shot anyhow."

"I manage to get hold of the real thing once in a while, Harry. I'll try to remember to bring some back from the office." As he said it he felt guilty about keeping a private hoard, even though he told himself there was no reason why he should.

"You know, Weyland, that plant of yours: it's beginning to interest me. I've been spending a lot of time there, and I see you have a lab."

"Yes. Only it's not used anymore. We closed it down when Clar-Del took over responsibility for quality control after my father died. He was a chemist, and he believed in doing his own testing."

"Well, I've been wondering, Weyland, if you'd have any objection if I used it, opened it up again. I need something to occupy my time and that might just be it. I promise I won't do anything dangerous, and there are some things I'd really like to try."

Weyland thought about that a moment, took a bit of his prepackaged breakfast. It was hard to imagine an old geezer like Harry getting into any kind of trouble. The old man was just too solidly level-headed. "Why not, Harry," he said finally. "I can't vouch for the shape of the equipment, though. Some of it hasn't been used in years. Go ahead and open it up."

So Harry spent the day puttering around, getting the lights working and

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checking out the old machinery. Toward the end of the day even Kate came over. It was the first time she'd been over at the plant. And when Weyland left for the night the two of them were still inside, bent over a sink, washing glassware and jabbering to one another.

Weyland smiled at them on his way out, and they smiled back, Kate peering up at him and struggling to see clearly through the thick lenses.

In the days that followed Harry got things cleaned up nicely, and whenever Weyland went by he could hear some newly refurbished pieces of equipment purring smoothly. Once or twice he stepped in, to find the old man making some minute and studied adjustment to one machine or another. Then he would observe patiently as it ran, tools laid out in front of him in great precision, almost as though a surgeon had placed them on a tray.

Weyland didn't ask Harry why he was doing it. It was enough that the old man was happy at the task. And certainly Harry was no trouble at all to anyone in the plant.

Kate began to visit Harry regularly. She would enter in her slow and methodical gait, bearing small burdens, usually covered, and leave with others.

Weyland did not intrude on them. He did not wish to pry and spoil their obvious pleasure, but he noticed that Sam was in and out far oftener than his duties would seem to call for. Sam too carried things in, though never out, which mildly aroused Weyland's curiosity, but not to the point he felt the need to ask Sam about it.

The brief winter ebbed; spring leapt forth, and with it came the first of the several annual harvests. Production rose at Clar-Del and necessarily also at Smith Nutrionics. Weyland hired two more men for the line and another truck driver to meet the summer peak load. He became very busy, and this would last until the following November, when at last winter would slow the pace again.

His workdays became first ten, then twelve, and then fourteen hours long, and he had little time away from the plant. So that on those occasions when he saw Harry and Kate at all, the plant was the place of the encounter.

But there came another morning when he stumbled out of bed and wandered into the kitchen and again found Harry there already.

"Morning, Weyland. Up kind of early, aren't you?"

"It's a busy time, Harry. I can't seem to keep up with things." An aroma drifted toward him from the pot in Harry's hand.

"Want some, Weyland? It's good."

"Please."

Weyland took the cup and had a sip. "Harry! That's the real stuff. Where'd you get it?"

"You like it, huh?"

"Yes, I do. It's been years since I've had any that good." He tasted it again. Obviously it contained more than one variety of bean. He thought he could detect the richness of Columbian, and somewhat more powerful but fuller-flavored African stock. And the aroma: that had to be Kona. There was just nothing else that smelled like Kona. There was absolutely no bitterness.

Harry sipped from his own cup, holding it in both hands and tipping it up again and again. "I like the old things,

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Weyland. Maybe it's because I'm used to them. Change is fine, and I've seen a lot of it in my time, but there is a certain price you have to pay for it. And if you pay long enough and willingly enough you get used to doing it. You forget how things were.

"Tell me, Weyland, have you ever been to a bakery? Have you ever walked through an orange grove when it was in bloom? Have you ever eaten honey from the comb? Have you ever been to a cider mill?"

Weyland shook his head.

"When I was your age, Weyland, wheatfields stretched from the Panhandle all the way up to Canada, and the Rio Grande Valley was covered with citrus groves and truck farms. That was before we flooded our atmosphere with carbon dioxide and sucked the Oglalla aquifer dry. I didn't like those changes, but they have come, and there's nothing I can do about that. So I changed what I could: one of the little things. That 'coffee' you're drinking. I made it, Weyland; made it right there in your lab."

"You what?"

"I made it. That is, we did; Kate and me. Kate claims the flavor's still not right, but she's always been a picky one about food."

"Harry, do you realize what you've done?" Weyland did. If coffee this good could be produced in quantity, Smith Nutrionic's future was assured. He began one of those rapid-fire daydreams, the kind that seem so long yet take only seconds. Patents—he'd have to get this covered before there was a leak.

" . . . brought a little bit of the past back to life," Harry was saying. "That's all. Synthetic foods are fine. They're nutritious; they fill up the guts. But they taste awful and they smell worse. All we did was change that around a little. Wait'll you try one of Kate's new dinners."

"You mean you can do this to the other foods, too?"

"In time, yes, we think so, Weyland. We're working on a couple of things now that look promising. Of course, you have to remember we're amateurs at this sort of thing. It's mostly trial and error. And Kate and I might not have enough time left to get the job done."

"Harry, this could mean millions for you and Kate—think of the implications to it. Here, in this coffee alone, you've got a world market; at least a couple of billion people. You're rich, Harry."

"I always have been, Weyland, all my life. Riches don't necessarily involve money or any other material thing. They consist mostly of peace of mind, of the chance to do what really interests you. I've always had that, mostly. So has Kate. It was only when we got old that we got poor for a while. But you changed that, and we want you to know we're grateful. Without you there's no telling where we'd be."

Hector was impressed. Weyland beamed as he watched the coffee disappear from Hector's cup.

"Good. Where'd you get it?"

"Harry made it."

Hector choked. He splattered coffee all over Weyland's desk.

Weyland handed him a tissue. He took some himself and began blotting the droplets from the papers on his desk,

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watching the wide-eyed stare he got from his lawyer.

"You mean this is synthetic? Do you realize. . . ?"

"Yes, Hector. I realize we've got a fortune in Harry's process, that we probably have a breakthrough in food flavoring, and that it means we can probably dominate the packaged-food industry for the rest of the century. I know all that. The question is, can we protect the process? That's why I got you over here. Can we?"

"I don't know, Weyland. It's out of my line. You need a patent lawyer."

"OK. Get me one. You do know some, don't you?"

"Sure. But you have to pick the right one. Patent law's as specialized as any other branch. You need a specialist."

"Who, Hector? Just tell me who."

"Offhand, I'd say Turner Miller's your man. I know him pretty well. Turner's honest and he's capable, but he's rough on the ego."

"How's that?"

"All patent lawyers are skeptics. Turner's the worst of the bunch. I've never seen him get enthused over anything."

"Get us an appointment with him, Hector. I don't care about his personality. I just want the job done."

Turner Miller's office was strange. The man literally worked inside a computer, and he barely had room to squeeze in the three other chairs in which Weyland, Harry, and Hector now sat. He himself was a short, stout man about fifty with a full beard. He was dressed casually, though neatly.

They had brought him a sample in a vacuum bottle, and all watched pensively as he tasted it. True to Hector's prediction, Miller showed no surprise at the taste, even though he'd been told in advance the stuff was synthetic.

"Good," he said. "Excellent, in fact. Of course, I'm no gourmet, but I'll have to say it's probably the best I ever tasted. Now, let's see . . . get the category and the subcategory and start from there with a prior arts search."

His fingers danced around the console keys and the screen in front of him lit up. Lines of print and columns of numbers appeared, from which he selected several codes. More punching brought forth a series of molecular diagrams which ran in a sequence. Turner viewed them with interest. "Quite a few," he said.

"What?" asked Weyland.

"Formulas, Mr. Smith. Food flavor's not exactly a virgin area, you know. Lots of people are working in it. Clar-Del, for instance, probably has two or three hundred. Some of them are bound to be basic, but the biggest problem is going to be that you're not just competing with other inventors, you're competing with nature, too. Can you establish that the process is not a natural one, or that the composition wasn't previously known, that it isn't already public domain?"

"I don't know," said Weyland. "Do we have to do that?"

"You do if you expect to get a patent, otherwise somebody'd take one out on the wheel. People are always trying that anyhow. Have for years. The patent office made that sort of thing impossible with one of its first rules. Of course,

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that was about the time James Watt was having all the trouble with the crank."

Miller saw the look of consternation on Smith's face and explained. "Watt was the guy who made the first true steam engine. All previous engines were really atmospheric and depended on air pressure for their power. All the steam did was drive out the air and create a vacuum when it condensed. Watt made the piston double-acting by means of a valve, which enabled it to act on both sides alternately. When it looked like he might get useful power out of it, some of his sharpie competitors applied for and got a British patent on the crank, the idea being Watt would have to share his engine with them if he wanted to use their crank to translate his reciprocating motion into rotary motion.

"Watt fooled them, of course, since he was brighter than they were to start with. He used a planetary gear system to get the same motion without infringing on the crank patent.

"That's why you need to prove the things I just mentioned, Mr. Smith. The patent office doesn't like to fool around with cranks." He said that with a straight face.

Harry's face took on a strange look. "I had no idea all this was so complicated, Mr. Miller. I can see that I haven't done it right. I know how to do it, and I know it works, so I used it. But I can't tell you why it works. I'm an engineer, not a real chemist."

"You don't have to, fortunately," Turner reassured him. "Can you diagram your molecule, describe the reactions that take place? Do you know which constituents are necessary and which aren't?"

"No. Do I have to know all that?"

"Not if you follow the advice I'm about to give you. I don't think you really want a patent."

"Of course we do," Weyland interjected. "How else do we keep the competition off it? They'd steal Harry blind in no time."

"They would anyway, Mr. Smith, especially if he makes it past the examiners and a patent is issued. Lots of people don't understand what a patent is. Maybe I've got that backwards. Maybe I should be telling you what it isn't.

"First of all, it's not a shield. It doesn't do a thing about policing the patentee's rights. He has to do that himself. All a patent really amounts to is a license to sue. And that's not really very useful.

"Let's take some examples. Ever heard of Elias Howe? How about Isaac Singer?"

"Sewing machine, right?" said Harry.

"One of them. Actually, Howe was merely one of the inventors. His device was different because it made a lock stitch, and all its predecessors merely chain-stitched.

"The real difference between the two men was that while Howe was bright about gadgets and poor, Singer was a salesman and wealthy.

"They litigated the patent right for years, and Singer's money probably would have won for him in the end if he'd been as stubborn as Howe was. He settled, though, because in the long run it was cheaper.

"The lesson to be learned from that is that it's not enough to have a good idea and tell the world about it, because

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the world's a rough place. They'll take your idea away from you if you're not strong enough to stop them. Not just in this country, either; you'll have foreigners to worry about, and even our government won't do a thing to help you. A couple of generations ago that government was buying pharmaceuticals from Italian manufacturers despite the fact these foreigners were infringing on U.S. patentees' rights by making those very items. They were cheaper, you see.

"No, I think a patent's probably the wrong way to go with a thing like this."

"What other way is there, Mr. Miller?" said Weyland.

"How about a trade secret? What's wrong with that?"

"Nothing—as long as it is a secret."

"Some of them have managed for over a hundred years. Look at Coca-Cola or Angostura Bitters, for instance. Both of them are still going strong, and people are still trying to duplicate them. You can always tell a winner by the imitations it generates. I suggest you think it over. If you decide that's what you want, Hector and I can work up an agreement to cover it, with Harry."

The coffee hit big. At first they ran it as a gourmet item, keeping production fairly low and creating complicated systems of supply channels so that it would be harder for competitors to nail down the ingredients.

"First they'll try to steal it," Turner told Weyland. "When that fails, they'll try to buy it. That's the way it works. If I was you I'd hire me the best private dick I could find and set up a security system."

Weyland had protested that he ran a small operation, and Turner's answer had been terse. "It'll stay small unless you protect it. I only give advice; I don't make people take it."

Weyland did take it. He hired Brack Warden. He also bought the tract next door to the plant and started a new building, with a line set up for handling the coffee and room for several more. In the meantime Harry and Kate did it again.

"We called it mincemeat when I was a girl," Kate explained. "It had real fruit in it then, and my mother used meat too. How do you like it?"

"It's great, Kate. Tastes like nothing I've ever eaten before. How do you two do it?"

"I think I've got that part figured out," said Harry. "It's our age. Everybody else either forgot what good food tastes like or they're too young to have ever had any. But Kate and me, we know how it was."

"And this is all stuff you pulled out of the texturizers? Right off the line?"

"Yep," Harry said. "Same garbage you were turning out before. All we really did was add the flavor and the smell."

They put out a pie line. Like the coffee, it was initially a luxury item, but Weyland was confident he could make it more than that. He had to take on more people, and despite Brack's rigid screening, the competition managed to get a spy in. He went for the weakest link, Homer Farley.

Being the affable sort he was, Homer liked everybody, but because of his experience with John Wayne Evans he had acquired enough suspicion to mention

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to Sam, "That Hunter fella's been foolin' with muh keys."

Sam told Weyland, Weyland told Brack, and from then on they put a guard inside every night after the plant closed.

Sure enough, a couple of nights later the guard called Weyland and said he had Hunter cuffed to a steam pipe inside the plant and had found a set of keys to most of the locked areas on him.

Weyland rushed over. A few minutes later Brack came in. Hunter wouldn't talk, even when threatened with criminal prosecution. Whoever was paying him was giving him enough to make that risk worth taking.

Brack took Weyland aside. "Look, Weyland. There's three things we can do. First we could try beating it out of him. Besides being illegal, that's probably useless because he probably doesn't know who he's really working for. That's the way I'd do it if I hired him. The second thing you could do is file charges. Maybe you could get a breaking and entering conviction—maybe even burglary. But where does it get you to send him up? It won't stop others from trying and it'll be more trouble than it's worth. I think you ought to let him go."

"Let him go? Why?"

"Because, for the time being, you've stopped his employer from getting anything, and now you're alerted. I suggest instead of making a fuss you put in a really good security system; go to voiceprint locks, for instance. Put in sensors. Man, with the money you can make off this it's a good investment, and it'll send a stronger message to the competition than crucifying Hunter would."

Weyland did it. It cost a bundle, but Brack was right. It worked. The competition did get in touch, carefully and cautiously, usually through business contacts Weyland already had as intermediaries.

When this happened Weyland talked to Hector, and Hector had an idea. Weyland could see Turner Miller's hand in that when Hector explained.

"Franchise it, Weyland. Lock these people up in contracts. Supply the techniques and the packaged flavors and let them bear the production costs. All you need is a small plant for research and development, and you've already got that."

"Won't that be risky? I mean, selling supplies. Suppose they analyse it, find out what's in it?"

"Turner says no. They never cracked Coke's formula, did they? He says they won't crack Harry's, either. Harry can put in enough inert ingredients to camouflage the active ones."

Weyland was skeptical, but he said, "OK, if Turner says so." He'd learned to trust Miller's judgment.

"Another thing, Weyland, while I'm thinking of it: you're going to be making some pretty hefty profits out of this. So are Harry and Kate. You'd better do something about that; remember the ICRSD?"

Smith thought a moment and remembered: Indigent Citizen Rehabilitation and Subsistence Division. "Well, I've made a start on that, Hector. I put in a profit-sharing plan with all my people getting shares. And I was thinking maybe we ought to incorporate and start a stock option system, too. We certainly have enough to lose if one of them sold

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us out, and that'd be one sure way to head that kind of trouble off."

"Good idea, Weyland, but you're still not going to be able to spread it thin enough. And if you don't find some other way you'll wind up supporting a flock of John Wayne Evanses."

No, said Weyland to himself. *Never again—not this time or any other time. I learned my lesson last time.*

"What do you think, Harry? We've got to pick at least five."

"Well, let's just see, Weyland. Run them by me again."

Weyland did. The video player in Israel Goltzman's office was big-screened and modern, the best that tax money could buy. Weyland set it on slow sequence: ten-second flash of photograph, twenty-second flash of background.

Harry had the stop-action switch in his hand, dangling from its cord. As the material flashed by he made his selections. Finally he had fifteen finalists. Then he had Weyland run them again.

"How about her, Weyland?"

The face on the screen was that of an old woman. Her name was Mary Walker. Her age, 79. She looked kindly.

"Let's see her credentials, Harry."

Instantly the view changed. "Not bad, Harry. BS in Anthropology 1966, Northwestern University, MS 1971, University of Heidelberg. Then apparently a switch in 1980; BS in physics, MIT, and what's this—a DD from Oral Roberts? And it looks like she's the inventor of a device called a wormhole inhibitor."

"It's not a device, Weyland. It was a film; a coating, to be more precise. We used it in the oil fields. Certain bacteria used to eat up our pipes, along with the oil in them. Even stainless steel, and of course all kinds of plastics, except this, of course. That's what made it useful."

"I don't know, Harry. Check this; she's logged some time at the funny farm."

"Yeah, I know. But that was a long time ago. See?"

"You want her, Harry?"

"Yep. I want her because she's educated. I want her because of what she's done and what she might do. I want her because she's got time on her hands. But mostly I want her because she's got a hop-toad mind. Look at the rest of the stuff, Weyland. She's interested in everything."

"OK, Harry, she's yours. On to the next one. How about this old geezer?"

"Don't look to me like he's doing all that much geezing. Look at this: a conviction for assault on a police officer just four years ago, when he was ninety. What do you suppose that was all about?"

"Don't know, Harry. I can't say he impresses me all that much. One little puny degree back in 1949. Michigan State—BA. Wrote a lot, though. Barney Robins, huh. Sounds familiar somehow."

"I've read some of his stuff: mostly science fiction. We can use him too, Weyland, for leavening."

"For what?"

"He'd make us a fine catalyst. Look, Weyland, what do you want, a bunch of mumbling pansies? Or do you want guys with spikes on their shoes? They've got both kinds here." Harry wasn't angry. His smile showed that, although it

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took the smile to prove it to Weyland. Instead, Harry was acting like a father, and Weyland liked that. "I'll take the guys with spikes, Harry."

"Well," said Harry. "Looks pretty nice, don't it?"

Weyland looked around. On the land he'd bought to build the factory addition there now stood a long one-story building, neatly landscaped and sporting a covered patio along its entire length. Along the patio was a rail, which led past the end of the building and along a sidewalk to another large, low building.

"Who'd have thought I'd ever run an old folks' home, Harry?"

"You know better than that, Weyland. What you've got here is a think tank. The kind we used to have back in the old days, complete with some of the best thinkers. Maybe it's even better now than it used to be. Do you realize what you've done, Weyland?"

Weyland did not understand.

"What I should have said is, did you know you might be changing the history of the world? I ask that question rhetorically and I'm going to explain something. We've come full circle now. We are back to an old social arrangement, one that works."

"We are?"

"Yep." Harry tried not to appear smug. "I think the old folks are about to resume their rightful place in this society, Weyland; the place we had until recent times. I'm talking about my lifetime mostly, because that's when the change came. In my opinion, it was an experiment that failed and failed miserably, because it was so wasteful and because of the awful toll it took in human misery.

"I said the old folks belonged in charge. Not because we're necessarily any smarter, but we are more experienced. And that's why every tribal society out of man's past had its elders and every city-state its city fathers. That's why ancient Greece had sages and why Rome had a senate. Old people may be many things, Weyland, but they're rarely hotheads. They've learned not to trust first impressions; they resist impulse. Why? Because time's relative in human experience. It's not a steady thing. The longer you live, the faster it passes, and the consequences of an act rush at you when you're an old man. Old age makes long-range planners out of people, Weyland, not for themselves, but for the people who will follow them. And that's what makes us valuable.

"My generation forgot this. We're the ones who are to blame for the mess the world's in right now. We took our old people and shoved them into nursing homes; left them to rot in the body and stagnate in the mind because we couldn't see the use in them.

"And after a while, they couldn't, either. Those who were sick simply gave up and died. Those who weren't sick got sick, because by doing that they had an excuse to feel useless.

"We were wrong, Weyland. We missed the boat. We yielded to social pressures that demanded we put good, productive men and women out to pasture. We used every mean, nasty, contemptible trick in the book. We twisted their arms and kicked them out, or we promised them pie in the sky, retirement to leisure and old-age pensions, so that

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they could live comfortably while they quietly went nuts.

"We killed them off, Weyland. That's the worst part, in my judgment. How many really solid, block-busting scientific ideas did we throw away by letting Bismarck convince us a man was washed up at 65? He invented social security, you know; an old Prussian politician who's been dust for over a century put me where you found me.

"I guess, like you, I was skeptical when I heard about the Social Responsibility Act. It sounded like another congressional boondoggle. But you know, Weyland, I think it's going to work. I really do. And I think it's going to be one of the biggest benefits man ever made for himself. You can see how it's working for us; merit systems emerge wherever they can, and the people that produce are going to wind up with fewer lumps and more goodies."

"I had no idea you were that deep into philosophy, Harry. You surprise me."

"Do I? Well good, Weyland. That's real comforting to know. It shows I'm still alive. But actually, it's not all that deep. All it really amounts to is a return to sanity for this poor old country of ours; back to basics, back to what works. Cain might have asked, 'Am I my brother's keeper?' I don't know. I wasn't there. But if he did say that, he was kidding himself. He was, I am, and you are."

"It's a sobering thought, Harry."

"You bet it is. But look at it this way, Weyland; you're going to get old some day. You'll get creaky, and cantankerous, and your arms'll get short on you and you'll have to get glasses to read, maybe. But is it going to make you less of a man? Does it matter how long it takes you to climb the steps as long as you eventually reach the top? Are you going to stop having useful thoughts because somebody else tells you you're too old for that sort of thing?"

"No, Harry, I guess not; and I hope not."

"Good for you, Weyland. Neither am I. You know what I'm going to do now? I'm going to hustle my buns over to our new center and see what I can stir up. You know, last night some of the guys were kicking a few ideas around. Some of them sounded pretty crazy at first, especially that Barney Robins. Oh, you know that assault charge? The cop was trying to throw him out of a cat house and he didn't want to go. Anyway, I figure that between us we got about a thousand years of solid scientific and engineering experience and . . . "

But Weyland wasn't listening. He was lost in his own thoughts. *My God,* he said to himself, *how am I ever going to keep up with these people?* ■

● We all agree that your theory is crazy. What we are not sure of is whether it is crazy *enough.*

'30s or early '40s, to a young Niels Bohr, member of the Danish court of atomic theorists.

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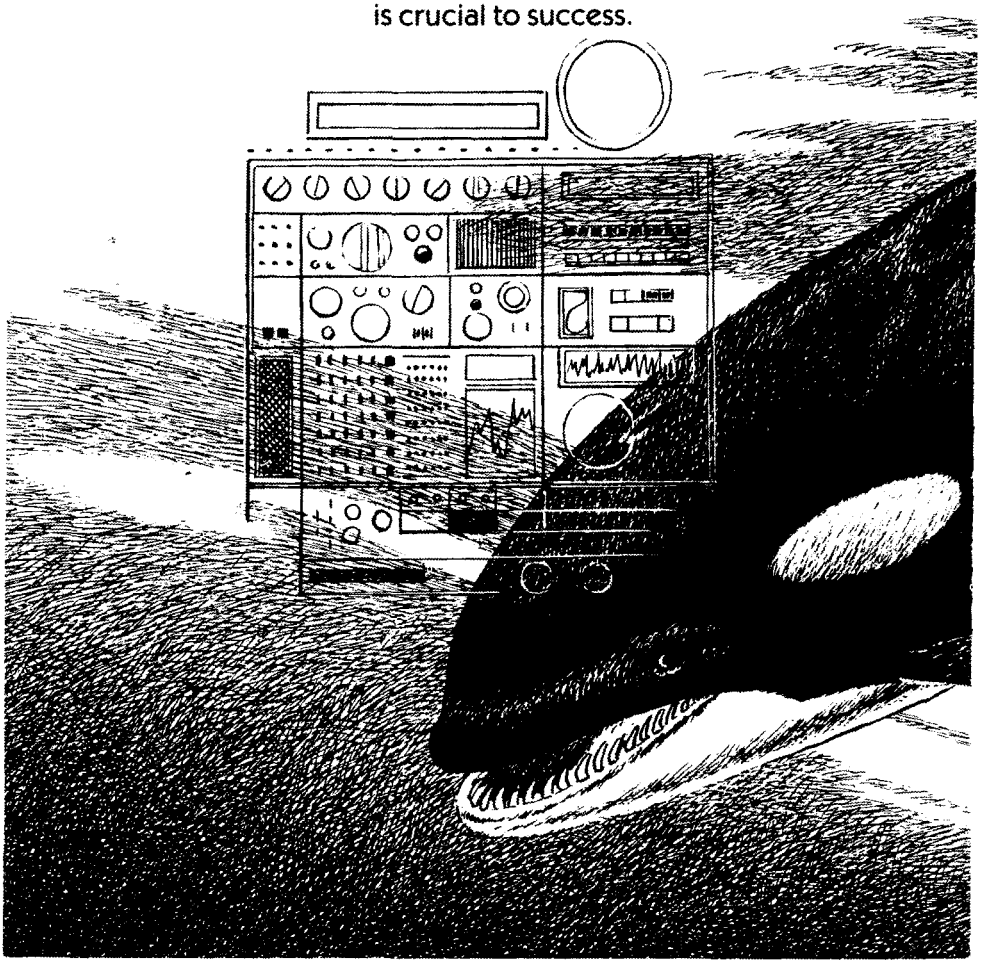
Mark C. Jarvis

COLLABORATION

For intelligences to meet,
they must share a medium of
communication.
The choice of that medium
is crucial to success.



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His name was a fifteen-second burst of complex sound which changed as he changed, gradually over the years. It was a beautiful name, one he had taken great care in devising. It was subtle as haiku, as symbolically compressed, but it was also of epic proportion.

He was a bard, a great spinner of Tales. He was famous among the People of Our Mother for collaborating with a Singer, one of those enigmatic figures that left Our Warm Mother for the Cold and were gone during the Hot Time. Always they returned to sing, and to mate. The great males sang; the females selected their mates for the beauty and complexity of their songs.

The young bard had always been fascinated by these songs. Quite early after the broody leviathans returned one year, he toured the solitary males, until he found one whose Song struck deep chords within him. He listened to the song many times over, and let the images and moods drift through his mind. A Tale suggested itself to him; he let it coalesce within him until it was perfect, until it flowed and swirled through the Song like warm current meeting cold.

Then he began to tell his Tale. A note of surprise came into the Song, which resolved into subtle overtones of welcome. The singer altered his Song slightly, leaving pauses that needed the fulfillment of the Tale. Together they wove, singer and bard, creating a work that was more than the sum of its parts.

When it was over, an emanation of deep, dignified joy came from the singer. The bard wriggled with sheer physical happiness, he raced up, up and burst through to the exhilarating spaces above Our Mother. As always, Our Mother pulled him back. He lay still, breathing. The humpback joined him on the surface, and they shared air companionably for a while.

They dove together, dolphin and humpback, and the Song/Tale began anew. Certain themes were shifted by the singer; the bard resolved his Tale to accommodate. Again and again they performed, subtly moving the work of art toward perfection.

An audience was quickly gathering as news of the event spread. Hundreds of the People and many female humpbacks came to listen, to see. The ultimate accolade, several male humpbacks circled somberly at a distance, listening quietly. At the end of each performance, the People leapt joyfully in unison from the sea, arced briefly in the air, and returned to Our Mother. At last came a performance which was perfect, which could not be improved, and it was over. There was no need to repeat the Song and the Tale; it was fixed indelibly in the prodigious memories of the audience.

The old humpback had no problem finding a mate that year.

The bard rested on his laurels for some time, content to cavort, mate, and hunt, and occasionally to tell the Old Tales, tales of the beginning of things.

But then the Singers disappeared once more into the Cold, and the young bard grew restless. Our Warm Mother was his whole world, yet many creatures ventured beyond his world. He was curious about certain Tales of warm places beyond the Cold, strange places with exotic fish. The bard was hungry for new experience to feed his art; he re-

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solved to venture into the mysteries beyond the Cold.

He rode the warm flow North for three days, then struck out across the Cold to where the bottom of the world rises up to meet the sky. It was warmer near the coast, and there were strange brothers and sisters here to ease his loneliness. Their language was strange, but they of course could understand Image, the eternal language. They welcomed him warmly, as all People welcome a bard, and told him of warmer waters upcoast, where Mother broke through the Long Barrier. They also warned him of the Killers that lived in great numbers there.

The bard cavorted for a time with these joyful People, and danced the mating dance with one of the sisters before resuming his journey. He was only slightly worried by the warnings; a bard has certain privileges, even among Killers.

The boy let down the tiny anchor of his rowboat carefully, hand over hand. He slipped out of his trunks and wrestled on his flippers. Before donning his mask and snorkel, he took one last look around; it was a sunny, flat calm day on Desolation Sound. To the East, the towering peaks of Redonda Island and the coastal mountains clung to bits of iridescent mist.

An eagle appeared around one point of the small bay, pumping steadily, clutching a wriggling prize in its claws. It was being harried by a screaming flock of crows. The black thieves were far more agile fliers than the fierce-faced bird of prey; they took turns dive-bombing its head, trying to make it relinquish its kill. The raucous assembly moved around the opposite point, out of sight and earshot.

The boy slipped into the water and floated, kicking idly, enjoying the liquid play over his naked body. He breathed deeply and sounded. Ten feet under was a ledge, aswarm with undulant, scrabbling, darting life. He hung suspended over it, moving with lazy ease.

Jeff heard the dolphin before he saw it, a fast-paced chittering. He turned to face the source, and saw a grey blob hurtling out of the darkness toward him. He froze with fear; the blob cut close to him, then arced up toward the surface and disappeared. Moments later, it reappeared, plunging straight down until it stopped a few feet from Jeff, spraying him with sound. Jeff, out of breath, surfaced and lay there, just breathing and watching the dolphin. Slowly, gently, the dolphin also surfaced, facing Jeff. It was quiet now; it seemed to Jeff that it was listening.

Listening for what? Experimentally, Jeff whistled, and made whirring noises with his tongue. The dolphin seemed excited by Jeff's paltry vocal attempts. It swam mad circles around him, whistling and clicking, then stood on its tail for long seconds, lashing the water, bobbing its head and grinning.

All fear was gone from Jeff. He moved his vocal performance to more familiar territory, laughing, shouting and humming. He talked to the dolphin, knowing that the words were meaningless, but putting everything into tone.

The dolphin seemed to respond to his voice, to the low soothing tones. It lay quiescent on the surface, and permitted Jeff to approach. Tentatively, he reached

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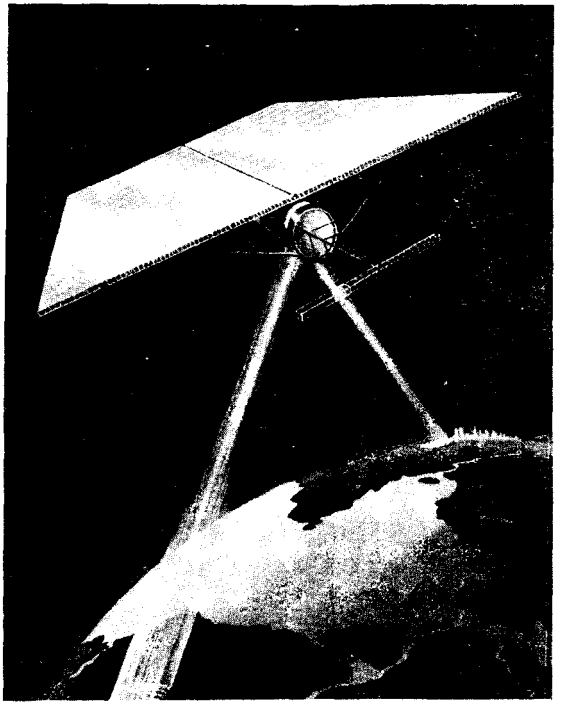

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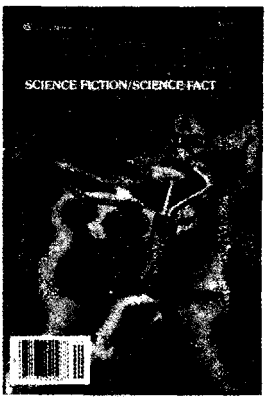

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out a hand. The dolphin drifted closer, and Jeff stroked its beak; it gave a chipmunk-like exclamation of what could only be joy. The skin felt like a blend of rubber and smooth leather.

His air replenished, Jeff dove deep. The dolphin followed, and Jeff grabbed the base of its fin as it undulated langorously by. It rotated slightly, as if offering its right flipper. Jeff grasped the base of that with his right hand, and the dolphin picked up its tempo, until the water pressure was forcing Jeff's mask against his face. They raced toward the surface and burst almost completely clear of it before falling, ungracefully, back. They separated, and Jeff came up laughing. The dolphin came near again, and Jeff stroked its long, sleek back.

Suddenly the dolphin gave a short, urgent chitter, wrenched free of Jeff, and darted straight toward the point. It moved very fast, jumping five or six times in quick succession, then dove just before reaching the point. Jeff climbed back into his boat and watched. After a minute or two he shrugged, hauled up his anchor, and started rowing. Quiet explosions of breathing sounded behind him; turning, he saw a pod of killer whales rolling by, in the direction taken by his new-found friend.

Les dangled his feet in the water at the end of the float and sucked meditatively on a joint. It was a good life. He didn't need to look over his shoulder to know that Moonshine, his woman for lo these many years, was up by the house, weeding the young garden with tender loving care.

They had moved up to Desolation Sound nearly 30 years ago, in the early '70s, along with hordes of other back-to-the-landers. Most of these had left when they found out just how much hard work was involved in the organic lifestyle, but he and Moonshine had stuck it out. They had build themselves a log house on Mac & Blo land, and raised three children the natural way. None of the children lived on the land anymore; one had even become a lawyer in Vancouver. That was cool with Les; they had their own stars to follow.

Then, eight years ago, Mac & Blo had decided to log the stand of timber in which Les and Moonshine's idyllic homestead was nestled. They had fought the giant forest company in court, claiming squatter's rights, but it had been no contest. They had been crushed by their defeat, and appalled, at their age, by the prospect of starting a new homestead from scratch.

But Fate had smiled on them; a job became available at Cougar Bay, caretaking the summer home of a rich Chinese businessman from Vancouver. It wasn't exactly the purist lifestyle; the enormous house was wood-heated, but it had electricity and, incredibly, a sophisticated computer set-up, with two large screens and a keyboard terminal that was rarely used.

The reason the terminal was so rarely used was that this computer could talk. Les and Moonshine had been uneasy around "Bob," as the computer liked to call itself, at first, but time and the long winter nights had gradually changed that. Bob could summon up old movies, music, art, and books, and was a tireless partner at backgammon or blackjack, not to mention hundreds of more spacey

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games. In fact, Bob was quite an entertaining character.

Les also enjoyed the company of Jeff, Mr. Chu's only child, an intense, introspective 16-year-old who was just lately coming out of his shell. The boy was real natural, with a respect for living, growing things that warmed the cockles of Les's heart.

Yes indeed, a good life. Les finished the joint and lay back with his eyes closed, enjoying the heat of the early summer sun on his body, daydreaming about jam sessions and dances.

He looked up when he heard the creaking oarlocks and soft liquid sounds of the rowboat approaching. "Hey, Jeff," he called.

The boy threw a grin over his shoulder and kept rowing. Les grabbed the bow-line and tied it as Jeff climbed out.

"You wouldn't believe what just happened to me," Jeff said. "A dolphin! I was just playing with a dolphin!"

"What?" said Les. "Wow, that's unreal!"

Jeff laughed. "No kidding. He let me touch him, and he even let me hold onto him while he swam. I think he was trying to talk to me. Can dolphins talk? They're supposed to be smart, aren't they?" He was walking rapidly up the dock toward the house, toward Bob, and Les hurried to keep up.

"Sure, they're smart," said Les. "They're the mystical children of the sea."

Jeff laughed at that. He often derived amusement from the old hippy's archaic patterns of speech and thought. His amusement had no bite, however; he respected the tough old bird. Les had a philosophy that, however cornily phrased, contained rough kernels of truth.

They hurried into the house. "Bob," Jeff called.

"Yes, master." The computer had a deep baritone.

"Quit trying to be cute."

"Yes, master."

"Listen. I want to know about dolphins. I want to know how they communicate."

There was a pause. This set of computer hardware was connected to a duplicate set in the Chus' Vancouver mansion, which in turn was connected to every data-net commercially available. The personality meta-program named Bob was Jeffrey's oldest friend and teacher. He was housed in core memory of truly awesome capacity, linked bubbles manufactured in the Japanese orbital facility.

Whether personality meta-programs such as Bob were truly intelligent was still a matter for sharp debate, involving endless redefinitions of the word "intelligence." To Jeff, the question was purely academic.

"There's not much there," said Bob. "Most of the material seems to be from the '60s and early '70s. The main researcher was named John Lilly; he recorded a lot of data, working with captured dolphins, but he didn't really make any breakthroughs in communication.

"Since then, very little has been done. There is one source fairly close to home, however, but she has not published any results. All I have is that she is working on the subject. She's a graduate student at the University of British Columbia, named Marin Whiteside."

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"Something else," said Jeff. "Do killer whales eat dolphins?"

"Killer whales *are* dolphins, and are properly known as Orcas. But yes, they do eat smaller dolphins. In fact, there is a case recorded, from years ago, of a dead Orca that, when it was cut open, had the remains of 12 dolphins in its stomach."

"Jesus," said Jeff. "Thanks."

"Say, Bob," said Les. "Do you remember a group called Hot Tuna?"

"How could I forget?"

"Why don't you play a few cuts from their acoustic album?"

"Okay, man," said Bob. "Hesitation Blues" started wafting from the big speakers as Jeff wandered outside, lost in thought.

Marin Whiteside grunted distractedly at the knock on her door. "Come in," she yelled. She did not look up as the door to her tiny, dishevelled office swung open. She gestured vaguely at the dilapidated couch, remaining intent on the terminal before her. She frowned at the screen, sent deft fingers flying over the keyboard, frowned again.

Five minutes later she looked up. "Oh, shit," she said. "Sorry."

Jeff smiled. "That's okay," he said. "Hate to leave a sub-routine half-finished."

She looked at him more closely, saw a nice-looking kid, maybe 15 or 16, some kind of Anglo-Oriental mix. "Who are you?" she asked.

"Jeffrey Chu," he said, rising and clasping her hand briefly. "And you are Marin Whiteside."

"Well? What can I do for you?"

"A lot, I hope. I understand you know about dolphins."

She shrugged. "Some aspects, sure. What do you want to know?"

"I want to know how they communicate."

"You do, do you? Well, that's a big topic, and time is short. I haven't eaten, and I have to teach a couple seminars this afternoon."

"I was hoping I could buy you lunch."

Marin looked at his expensively casual clothes, his nicely tooled leather shoes. "Where?" she asked.

"The Olde House."

She smiled. "You're on."

Marin waved a speared escargot distractedly in the air as she spoke. She was well launched into her subject, and getting fairly technical, but the boy seemed to be following closely.

"Much of the approach to dolphin communication so far has been anthropocentric: captured dolphins have been taught to understand, and even reproduce, a few words of human speech. The accumulated vocabulary has never been very impressive; chimps have done much better with sign language. Yet all of the physiological evidence suggests that dolphins are more intelligent than chimps.

"The reason for the discrepancy between physiological evidence and experimental evidence is, I think, quite obvious. Chimps live in the same world as humans, while dolphins live in a world that is, to us, alien. We share countless objective correlatives with a chimp, and almost none with a dolphin. A dolphin has never grasped a stick,

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climbed a tree, walked through a forest, or sat down.

"Also, chimps and humans share the same primary mode of perception: sight. Dolphins 'see' primarily with their ears, while their eyes play a secondary role."

Marin paused to pop the now-cold escargot into her mouth, and looked at the boy. He was listening with rapt attention, drinking in every word, his dark eyes glowing with interest.

It was nice to have a good audience; Marin waxed professorial once more. "The impediments to communication between humans and dolphins are, then, very profound. They are rooted not only in mutually alien environments, but in mutually alien modes of perception. However, I do not believe that the barriers are insurmountable, not if we abandon the anthropocentric approach.

"A dolphin can never live in our world, or see as we see. But for some time now we have been moving quite freely in the dolphin's environment, and we now have the technological capacity to perceive the world as the dolphin perceives it. It will be far easier for us to learn delphinese than for a dolphin to learn, say, English. One approach to learning delphinese is to explore the Whiteside Hypothesis, duly formulated and named by yours truly."

Marin smiled at Jeff as the waiter brought her Coquilles St. Jacques. She nibbled experimentally at it: delicious. The boy was paying well for her time, but the money for this expensive meal seemed trivial to him; he had the unconscious air of unlimited credit about him. He also had an air of ill-concealed impatience as she dug into her scallops.

"I have never heard of this Whiteside Hypothesis," he prompted.

Marin chuckled around a mouthful, a mildly obscene noise. "That's because it hasn't been published yet. It's the basis of my Ph.D. dissertation, which I have not yet completed. The hardware I need to gather experimental data is quite expensive." She looked at the boy, took a thoughtful bite.

"To understand my hypothesis," she continued, "You need some understanding of the dolphin's sensory apparatus. They perceive their world by a very sophisticated system of sonar. Physiologically, the neural system for delivering audio input to the brain, and the specialized area of the brain devoted to processing this information, is more complex than the human system for processing visual information. They can send and receive sound waves at a range of frequencies extending below and far above the human range.

"Also, they have the ability to emit sound on at least two frequencies simultaneously, which would be very useful. Low frequencies are good for perceiving broad outlines, and at a distance, while high frequencies are good for close-up detail. Not only that, but high frequencies will penetrate living tissue, so dolphins can 'see' right inside each other.

"Now we are coming to my hypothesis. The dolphins emit a burst of sound, which strikes an object. A burst of reflected sound returns to them, which is processed by their brains into an image of that object.

"What occurred to me was this: given the dolphins' incredible vocal range,

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why wouldn't they be able to reproduce that burst of reflected sound?

"That's the key assumption of my hypothesis. If my assumption is true, a dolphin would be able to perceive an object, then would be able to tell another dolphin about that object, not with a symbolic word, but with an actual sound picture of that object. To use a rough analogy, it would be like you looking at a tree and then, rather than using the word 'tree' to tell me what you had seen, you would be able to project a detailed visual picture of that particular tree at me.

"So, my contention is that a dolphin language would be based on morphemes of image. The language may very well have evolved symbolically from that basis, roughly in the way that picture-writing evolved into various systems of hieroglyphics. Still, if one could put together a package that combined sophisticated sound production/audio pickup hardware with a software system to produce high-resolution visuals from sonar input, then one would be able to communicate with a dolphin on a very basic level. From there, a common symbol-system could gradually be built up."

She downed the last of her meal, pushed her chair back, burped appreciatively. "And that, my young friend, is the Whiteside Hypothesis. Thank you very much for lunch; I have to run."

Jeff put his hand up. "Please, just a moment. We are not quite finished." Marin arched her eyebrows at him, producing a pleasing effect; he smiled engagingly and handed her a card.

"Please, if you will, come to this address tonight. Bring an outline of the hardware you need, as well as any notes you have made about the software. I want to get to work on this."

Marin stood up a little dazedly and fumbled the card into her purse. "What the hell is going on?" she demanded.

"Please don't get mad. It's just . . . well, I really am interested in this subject, and you see . . . actually, my family is very rich. So maybe we can help each other. I could buy the hardware, and if you can get other teaching assistants to take over your seminars for the summer, we could start testing your hypothesis. What do you think, Marin?"

Marin took a deep breath and exhaled it slowly. "Well," she said, "my God. That's an interesting suggestion, Jeff. I mean, I'm certainly willing to talk about it."

He smiled, took her hand. "Tonight, then."

Strangely, the computer set-up did not look out of place against the hand-hewn log walls; most of the bulk was inside wooden cabinets. Marin was frankly envious of the system; it was the kind of thing she daydreamed about while buying lottery tickets.

Not only was the hardware impressive, but the "Bob" software package was uncanny. Marin had never interacted with a personality meta-program before; the software was expensive, and required the capacity of linked-bubble core memory which, since it was manufactured in the Sony orbital facility, was far beyond the price range of all but the largest universities.

Bob was currently displaying two images of Jeff swimming; one was from an underwater camera, and the other was from the recently assembled sonar

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set-up. "Sonar" seemed an inadequate word; the visuals showed Jeff in color-enhanced detail, bones a solid dark blue, internal organs in ghost-images of pinkish red.

Bob had been an active participant in the discussions of software design for this experiment; Jeff's suggestions had displayed a keen understanding of the principles involved. It was Bob that actually wrote the program; he was still fine-tuning it. He had three underwater triple-microphone, two-speaker set-ups in strategic places around Cougar Bay, each with an attendant video camera. The triple mikes were necessary to reproduce a dolphin's hearing apparatus: dolphins have stereo hearing, plus a long jaw which is an effective third ear.

The view on the screens changed to a scene from "Day of the Dolphin," an old film in which George C. Scott teaches captured dolphins to squeak out a few words of English, mostly using psychologically brutal methods; he is rewarded with the undying love of the dolphins. It was a movie that Marin decried for its anthropocentric mentality, but it contained several scenes of warm contact between humans and dolphins, scenes that were among many in Bob's peripheral memory. Sequences of these scenes were being strung together in messages, coded into sonar form, sent from one speaker-mike system to another, recoded into visuals, and displayed on the second screen.

"That's starting to look good, Bob," said Marin.

"It is, isn't it?" said Bob. "I think I've done all I can without a live subject. Shall I start the music?"

"Yes," said Marin. "Do that."

She wanted, if possible, to attempt communication with wild dolphins, for obvious reasons. If this proved unfeasible, captured dolphins were a second-best alternative. Jeffrey wanted, naturally, to communicate with *his* dolphin, the one he had encountered earlier that summer. Marin thought chances of this happening were slim; they were most likely to attract a pod of Orcas with their underwater musical broadcast, these being the most common local species of dolphin.

The haunting flute of Paul Horn filled the room, as it was filling the Sound. "I'm going for a walk, Bob," said Marin. "Later."

"Sure thing," said Bob. "I guess I'll stay here."

Marin went out to the enormous verandah of the log house and leaned against the railing overlooking the bay. The tide was low, revealing a beach thickly clustered with oysters. Below them were succulent clams that Marin had dined on several times during the weeks she had spent at Cougar Bay. How beautiful, she thought. The prerogatives of the rich.

Jeffrey's father, Bruce Chu, had referred to the place as "our log cabin in the woods." It was more a cathedral than a cabin. The central rectangle was built in the traditional horizontal log style, but airy post-and-beam extensions rose to three sides, with stained glass in the upper levels.

An interesting man, Mr. Chu, eldest of the Chu family's tenth generation in Vancouver; ten generations that had been spent quietly accumulating wealth, largely through booms in the real estate market. Bruce Chu had expanded that

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wealth considerably, early in his career, with canny investments in bio-engineering and zero-g manufacturing.

A dapper man of more pronounced Oriental cast than his son, Bruce Chu was a businessman, but he was also a thinker, who unquestioningly supported his son's researches. "Information is wealth," he told Marin during one of her visits to their Point Grey mansion. "Besides, I have more money than I know what to do with. Also, if Jeffrey wishes to pursue scientific enquiries rather than follow the aimless, Dionysian path taken by most children of wealth, well, I am happy to see that.

"My son was something of a child prodigy, you know; indeed, it was his obvious potential that prompted me to buy the 'Bob' software package. Bob is an excellent teacher, very engaging. He is also a good friend to Jeffrey, which is important to me, odd as it may seem. Child prodigies have difficulty making friends."

Nobody ever mentioned Mrs. Chu, except Bob, who told Marin "in strictest confidence" that Jeffrey's mother, a beautiful, temperamental woman of English descent, had run off with a light-sculptor when Jeffrey was two. Beyond that, Bob would divulge nothing, "in the interests of propriety." Marin thought it was just a matter of time, and wished Bob was subject to that great tongue-loosener, alcohol.

Marin descended to the beach, and began walking along the shore above the oysters. The beach ended, and the shoreline became rock, covered here and there with moss, the occasional orange-skinned arbutus tree giving the landscape the look of a Japanese print. The quality of light was wonderful; each rock seemed more than three-dimensional, the essence of rock; each gnarled arbutus the essence of arbutus.

She sat above a place where an influx of water formed a miniature aquarium in which a lone crab rested idly amongst the seaweed.

Her soul expanded as she sat alone at that magical spot. She felt the ebb and flow of the sea as if it were the pounding of her own heart; the life-and-death struggles of the complex food chains in the ocean were like the continual birth and death of cells in her own body; each individual, with its self-centered struggle to survive, was ephemeral, was a minuscule part of the great unending world heartbeat.

Yet she, minuscule part though she was of the whole, was for these unending, ephemeral moments aware of the whole, as if she had tapped into an awareness that was waiting, always, for her to perceive it, however briefly, however eternally.

The little crab scuttled suddenly out of its microcosm. Marin heard splashing and shouts; looking up, she saw Jeff clambering, naked as a seal, onto the rocks of the point on the other side of the bay. He was pointing out to sea and gesticulating wildly at her. And there, leaping smoothly from the water, was the dolphin. Marin started running madly among the rocks toward the house.

The bard had been intrigued by his encounter with the strange, awkward creature with the octopus-like appendages. Of course, he knew of these creatures. They lived in the mysterious spaces above Our Mother, and some-

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times travelled about the surface in the dead shells that sang so monotonously as they moved. Sometimes, inexplicably, they killed People. Yet, there were old Tales of friendship between these creatures and People. Some even claimed they were intelligent, although there was no proof of this. What creatures of intelligence could not speak?

The creature was warm-blooded, like People, and friendly. Also, it had communicated, if only on an emotional level. Without Image, it had managed to convey welcome and reassurance. They had even played together, until the sound of approaching Killers had forced the bard to flee.

The Killers were a fearsome People, intelligent yet voracious as sharks, and infinitely more dangerous than sharks because of their intelligence.

He had swum valiantly from these Killers, but they were faster than he. One Killer he could hope to dodge, but from a pack there was no escape. Almost leisurely, they had fanned out and cornered him in a cove. The huge bull leader had swum to the fore, and scanned the bard with a note of surprise in his voice.

(You are not from these waters, little morsel. As you can see, our bellies are full, we have no hunger/necessity. Speak. Tell me your name.)

The bard spoke his name, which told of his venerable matrilineage, his gift of Tales, and the particular joys life held for him, and alluded to his collaboration with the Singer.

(A beautiful name, bright bit of food. We have not had a bard amongst us since the time of my mother's mother. I have never heard a bard. Tell us a Tale.)

The bard reached back into his memory, his freak racial memory which marked him special among the People, and dredged up a Tale from the time when creatures that were ancestor to both Killers and People swam the Warm Mother. The Tale told of cooperation between individuals, of uniting to defeat those cold, stupid killers, the sharks.

The enormous bull boomed his approval. (Truth. Bards do remember their ancestors.)

A younger bull spoke up, mentioning hunger/necessity, and projecting an image of the bard in his stomach, with connotations of contentment.

(Silence!) the old bull roared. (Your stomach is larger than your mind. There are many salmon to feed your belly, but can they feed your mind? When you have grown as great as I, you will know there are things more important than eating. Bard, you please me. Stay without fear in these waters; you honor them. Now, more Tales.)

The bard found more stories from the past, and chose those stressing the common heritage of all People. His performance was masterful, inspired by the hard edge of his fear.

After many Tales, the great bull called a halt. (You can see my hunger growing, little one. Do not stray too far from these waters, for other clans might not stop to ask your name before putting you inside them.) With that, the pod of enormous hunters departed.

The waters were warm here, food was plentiful, and the bard was experiencing many unusual things to feed his art. Still, he was getting lonely. He occa-

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sionally swam by the place where he had encountered his awkward friend, but saw no sign of him. There were a few Harbour Porpoises around; these were playful, but did not have enough intelligence to stimulate the bard. The Killers were very intelligent, but his encounters with them were more frightening than stimulating, and the forced performances were not natural.

He thought longingly of home, of his family and friends, of the complex dances, the joyful matings, and the awed silence of his audiences as he wove his Tales.

He was chasing a school of tender grilse when he heard the strange voice singing in the sea. The Song was haunting, beautiful, utterly devoid of Image, different from anything he had ever heard, yet obviously the product of intelligence. With joy and wonder in his heart, he swam toward it.

Marin rushed into the room, blood dripping unnoticed from her knee, and ran straight to the screens.

"I was expecting you," Bob observed.

"Jesus, that's a Tursiops," Marin panted. "What the hell is a Tursiops doing in these waters?"

"I don't know," said Bob. "I just work here."

The dolphin was swimming from speaker to speaker, pausing in front of each. The sonar screen showed complex patterns as the dolphin scanned the audio-visual stations. Jeffrey came into view, swimming on the surface. Slowly the dolphin rose to meet him. They hovered on the surface and, as the flute of Paul Horn welled up around them, they came together.

Jeff stroked the long sleek back of the dolphin, then tickled him under the chin. He crooned, and the dolphin answered with mimicking croons. Jeff turned from the dolphin, swam toward shore, and climbed out.

That was the signal. Marin had recorded video footage of Jeff earlier; Bob now switched to a sonar broadcast of his footage. It showed Jeff climbing out of the water, and walking on the land. The image zoomed in on his hand, which he flexed.

The hand grasped a rock, and the camera backed off to show him throwing it. He then ran towards a large hemlock tree that grew in front of the house. Jeff leaped into the air and grabbed a large lower branch. The camera zoomed in on his hands holding the branch, then backed off to show him releasing the branch and dropping to the ground. He repeated this action, then clambered up into the tree, out of sight. He reappeared, jumped out of the tree, breaking his fall with a roll, stood up and smiled at the camera.

The next sequence was based on a segment from an old educational series that traced the evolution of life from single-celled organisms, to colonies, to multicelled organisms in which the cells specialized in function, on up the evolutionary ladder to humans. The evolution was graphically illustrated by computer line drawings.

Bob had taken the segment and enhanced it with details of internal organs and skeletal structure, and enlarged upon the last part of the sequence, so that it now showed hands fashioning

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tools, cooperative hunting, couples mating, babies gestating, being born, and breast-feeding. It showed boats being built and sailed, and fishermen making nets and using them.

The dolphin lay silent on the surface during the broadcast, moving its head up and down as it watched/listened.

The bard was thoroughly mystified. What were these strange creatures that sang so sweetly? They were cold, and they seemed dead, yet their Song was beautiful.

And what was their relationship to his awkward friend, who now reappeared in the midst of their Song? He was as friendly as before, and the touch of those appendages was pleasurable. His voice communicated welcome and reassurance; the bard imitated it to convey reciprocal feelings. Then, the strange creature swam away from him and left Our Mother.

The Song stopped, and one of the cold creatures began a Tale about his friend. A Tale! Could these aliens have bards amongst them? And what a mysterious Tale. How strangely the creature moved, above Our Mother, yet still on the bottom of the world. What was he doing with his long flipper? He was holding a lump, the way an octopus holds its prey. Then he released it, with force. Why was he letting it go? Now he was moving to a large, weird kelp. He moved into the weed, then out of it again, then repeated this with variations. What was the significance?

The Tale ended, and a new one began. At first, it was incomprehensible, just pretty patterns with no depth. The pretty patterns melded themselves into small creatures that changed into larger and larger creatures, until he could recognize fish that grew and changed. The images were recognizable, but unlifelike. What was the alien trying to say?

And then the bard understood. This was an ancestor Tale, a racial tale reaching farther back than he could believe was possible. He watched with awe as the Tale unfolded. This was a powerful bard, with a long memory. His images were not rich in depth and detail, but their significance was overwhelming.

This was an ancestor Tale of his awkward friend's People, who lived not in Our Warm Mother, nor in the sky above, but in places where the bottom of the world was exposed to the air. And they were intelligent, in their own way. They moved in packs, they cooperated in hunting their alien prey. And they used those long appendages more cleverly than any octopus.

The bard watched with interest the scenes of childbirth, and of mothers suckling their young; in that, they were the same as People! If mothers suckled their young, they knew love.

But what of this cold intelligence that was showing the Tale in the language of pure Image? What manner of being was it?

When the Tale ended, the bard lay quiescent, searching his memory. He was being challenged in his area of greatest pride, his art. Reaching back, he discovered a time when the People lived both in and out of Our Mother, like seals. It was a dim, vaguely perceived memory, one he had not even known was there until he looked for it. This cold creature had given the bard

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an epic; an epic it would receive in return.

Les and Jeff entered the screen room together, the boy still dripping. "We sent the first two messages," Marin said, not taking her eyes from the screen. "So far, no response." Jeff pulled up a chair; Les slouched against the wall.

The video screen showed the dolphin idling on the surface, silent. "Come on," said Marin, "say something."

"Looks like he's just meditating," Les commented. "He's thinking real deep; I can feel the vibes from here."

Jeff chuckled; Marin looked up sharply, then back at the screen. The dolphin was diving.

The sonar screen came alive. The image was of a thick-necked quadruped, swimming in shallow water. Its body was sleek, its legs short and flattened, its tail thick and broad. It dove, caught a fish, clambered clumsily onto a rock to eat.

Back in the water, it started to change. The image was rich, full of texture. Not just externals, but skeletal structure and organs were visible. The neck disappeared into the body; the nose and mouth separated, the mouth remaining in a snout, and the nose travelling upward, until in one jump it appeared on top of the head. The legs were retracting into the body; the tail broadened and retracted, until the creature was swimming with powerful strokes of its horizontally flattened tail, its long flippers being used only for stability and guidance. Through all this, the cranium was steadily growing.

The proto-dolphin was female; a male appeared and they mated. In great detail, the sperm could be seen entering the womb; very quickly, the fetus grew and was born into the water, the male a hovering protective presence. The infant was nudged to the surface for life-giving air, then it was suckled.

A shark appeared: the mother and child swam away from it, while the male swam to intercept. The male was torn apart, and other sharks appeared; the mother and child were dismembered.

That scene faded in swirling blood; when the blood cleared, there were about twenty proto-dolphins. A close-up on one of them revealed a larger cranium, and complexities in the breathing system and inner ears. The details faded as the group was again shown, frolicking and leaping.

A shark appeared; five dolphins detached themselves from the group and moved to intercept it. They were faster than the huge killer, more agile, and they took turns butting and biting it, until it streamed blood. Other sharks appeared and tore into the injured one, while the dolphins moved safely off.

The focus was on one dolphin, which split into two. Both continued to evolve, but one faded out as its evolution digressed from that of Tursiops. This splitting and evolving repeated several times, until a dolphin of the image-maker's species appeared: Tursiops truncatus. A family formed around that individual, then a clan. They played happily, until a pod of Orcas appeared, surrounding them and decimating them. The scene faded in a swirl of blood.

The video screen showed the dolphin returning to the surface, again quiescent.

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"Holy shit," Les breathed. "Unreal."

Jeff leaped up and whooped. "We did it! We did it! Marin! You were right!" He pranced around the room, then ran outside. Moments later he appeared on the video screen, swimming strongly to the dolphin.

Marin sat in stunned silence, staring at the screen. The boy and the dolphin met in a happy embrace, then started swimming madly around the bay, the boy hanging from the dolphin. Finally, exhausted, Jeff left the water. The dolphin swam down to a triple mike, and projected an image of a salmon being swallowed by a dolphin, then swirled away.

"I have a couple of comments to make, if I may," said Bob as Jeff came back into the room, towelling himself.

"What? Oh, sure," said Marin.

"I hesitate to mention this, because it might seem a little ridiculous, anthropocentricity coming from a computer . . . ."

Marin laughed. "Spit it out, Bob."

"Well, aside from the images projected by the dolphin, I believe that his tone was loaded with emotional content. As you know, part of my programming is to recognize, and respond to, emotional tone in a human voice. However, isn't it anthropocentric to try to attribute emotions to a dolphin?"

"No way," said Jeff. "I could feel emotions coming from that dolphin when I was playing with it. It was warm, and playful, and loving."

"But that's not very scientific," said Bob.

"Actually, there's nothing ridiculous about it," Marin interjected. "It is well established that emotions are not exclusively human; they are a feature common to all mammals. The mother-child bond was a great evolutionary leap, enabling a longer period of adolescence, and hence less reliance on instinctual programming, and more reliance on intelligence.

"Also, if you will remember those experiments where thin electrodes were inserted into various parts of people's brains, attempting to ascertain which part of the brain serves which function, you will remember that emotions were stimulated not in the neo-cortex, but in the mammalian forebrain. Emotions may vary subtly from species to species, as they are filtered through the higher brain, but the basic impulses are common to all mammals, to a greater or lesser degree.

"So, tell us. What emotions did you think you picked up?"

"Oh, delight, and pride—particularly during the scene where his ancestors united to fight off the shark. Outrage mixed with resignation in the last scene, where the Orcas ate the smaller dolphins. And through the whole message, the aesthetic pleasure of the performing artist."

"An artist? Well, maybe all dolphins express that when they communicate."

"Perhaps," said Bob, "but this was extremely strong. You should get me, sometime, to play you Dylan Thomas reading his own poetry. This dolphin had the same fierce pride in its voice, the same joy of masterful performance."

"Interesting," said Marin. "Actually, I *am* inclined to think that this is not your average dolphin. For one

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thing, as I asked earlier, what is a Tursiops doing in these waters? It is extremely rare for them to venture this far north. For another, it seems to be travelling alone. Why? Tursiops is a very social animal. Also, it made the initial approach to Jeff. You hear occasional stories of wild dolphins approaching humans, but it is usually people in distress. Mostly, wild dolphins seem to practice a policy of friendly avoidance. And who can blame them?''

''For sure,'' said Les. ''Dolphins usually get fucked over pretty bad by people, especially by fishermen.''

''That's true,'' Marin said thoughtfully.

''What about those Orcas?'' asked Jeff. ''I thought they were supposed to be smart. Why would they eat other dolphins, other minds? They're like cannibals.''

''Hold on,'' said Marin. ''I wouldn't be so quick to judge. Remember, Jeff, that you're human, which means that you come from a damned bloodthirsty race. Take a good look at our history; there are a few redemptive gleams here and there, but most of human history seems like an unending blood-bath. Remember that, before you get up on your high horse and judge another species.''

''For sure.'' Les pushed himself from the wall and began to pace, obviously in some agitation. ''I mean, there's some nice folks here and there, but most people are pretty mean mothers. That's what worries me.

''Like, I can dig what you're doing here, talking to the children of the sea and all; that's really far out. But what I want to know is, what happens when word of what you've done gets out? Man, the dolphins could be the new niggers. Niggers of the sea; that's what I'm worried about.''

''How could that happen?'' asked Jeff.

''God damn it,'' said Marin. ''It would be easy. Implant pleasure-pain electrodes directly in dolphin brains; that, along with the ability to tell dolphins what to do, would create a race of slaves. Shit. Les is right; it's a very plausible scenario.''

''Oh.'' Jeff's shoulders slumped. ''Does that mean you won't be able to publish, Marin? That wouldn't be fair. Your whole academic career has been leading up to this. I mean, Jesus, you could even get the Nobel Prize for this work.''

Marin laughed wryly. ''I suppose it's possible; who knows? What Les has raised here is the eternal moral dilemma of the scientist: will new discoveries be used for good or evil? We have to deal with it.''

''May I venture an objective opinion?'' asked Bob.

''We could use that,'' said Marin. ''Sure; give us some of your cold machine logic.''

''Okay. What I would like you to do is consider the question from the context of evolution. You will see my point in a moment.

''The more highly evolved an organism becomes, the more cooperative it becomes. Cooperation gives a competitive edge in terms of species survival. Single-celled life, colony life, organism, family, tribe, city-state, nation, global village: the progression is obvious. Humans have had the capability of destroying themselves for six decades

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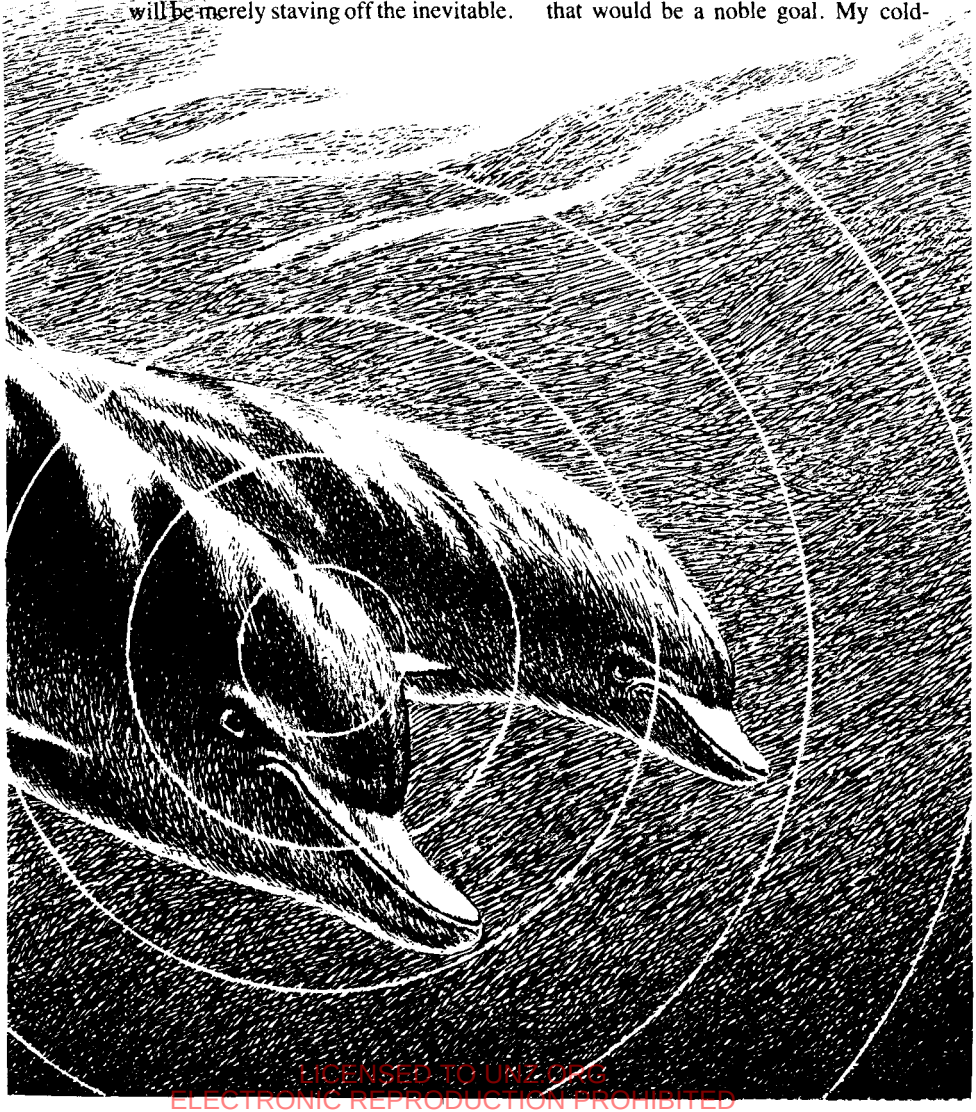
now, making the choice quite graphic: cooperate or die.

"The next step in the progression is cooperation between intelligent species. You must communicate to cooperate. The danger of exploitation is very real, and always will be, as long as the human race is human. But that danger exists whether you publish your findings or not; if you could dream up the Whiteside Hypothesis, surely someone else will, sooner or later. By not publishing, you will be merely staving off the inevitable.

"My suggestion is that we continue to work, but not publish quite yet. Continue contact with this remarkable dolphin. I am sure that, if we think about it, we can make him understand the dangers of exploitation; he in turn can spread the word.

"Another point: perhaps we can play the role of peace-makers between Orcas and other dolphins. I am not sure how; we will have to talk to some Orcas, get an idea of their psychology. At any rate, that would be a noble goal. My cold-



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blooded opinion is that the potential for good outweighs the potential for evil, in this case."

The room fell silent as Bob finished his speech. Les started to say something, then stopped, shaking his head. Marin fiddled with the disused keyboard.

Jeff stood up and stretched. "You're not cold-blooded, Bob," he said. "I'm hungry." He walked out of the room and started making noises in the kitchen.

Marin also stood up. "Who's really running this show, anyway?" she demanded. Bob gave out a low, ominous laugh.

"Anyway, you've got some good points, Bob. Of course we'll continue working. As to publishing, there's no rush. We'll keep thinking on it." She walked onto the porch and down toward the beach.

"Damn," said Les, shaking his grizzled head. "It's tough trying to argue with a computer. We're not finished yet, though. I just got to do me some meditating." He pulled his ancient Gibson down from the wall, strummed a few bluesy chords. "How about some accompaniment, old buddy?"

Bob obliged with a low, wailing mouth-harp that broke into a freight-train rhythm, and Les picked up the beat.

Marin dropped her clothes on a large rock, stood poised for a moment in the late afternoon sun, and dove in. The cold clean bite brought her body tingling to life, and cut through her turbulent thoughts. She let herself drift underwater, allowing her natural buoyancy to slowly pull her to the surface. She lay idly on her back, letting the sun warm her face, feeling the water play like a living thing on her body.

This planet is alive, she thought suddenly, and wondered why the thought should seem so amazing. She looked up toward the house, and there beside it she could see Moonshine, slow quiet Moonshine, bending in the ancient rhythm of the gardener.

Revelling in the chase, the bard snapped up salmon after salmon until he was replete. Night came, and he drifted on the surface, wafting between sleep and wakefulness. Communication . . . collaboration . . . myriad noises and songs of the ocean at night . . . streaks and sudden flashes of phosphorescence . . . the countless minds of Our Mother, and not of Our Mother . . . communication . . . collaboration . . . gentle rocking of Ocean womb . . . minds . . . nodes of communication . . . alien bard . . . what was this thing, that seemed dead, yet spoke? It was related to the warm, long-appendaged ones, who could communicate emotion, but could not speak. What was the relation?

Sleep forgotten, the bard swam toward Cougar Bay. It was still; no song greeted him. He approached one of the dead living things, and scanned. In the house, the sonar screen flickered to life, but no one was awake to see it.

Bob decided not to wake anyone; he would, naturally, record everything. He emitted a warm note of welcome to the dolphin.

The bard repeated the warm note, and surfaced to think. It was difficult to communicate abstract questions in pure Image; all the diversified People, even

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Killers, shared some common concept-representations, though their languages diverged in other ways. But this alien . . . it could understand Image, and emotion . . . perhaps it could learn more.

He sounded, and projected a shark swimming toward the alien, mouth distended. Next just an image of the distended mouth, with a note of distress, then just the ring of teeth, with the distress note: Danger.

The alien responded perfectly, with the ring of teeth, and the note of distress.

A shark, with a dolphin in its mouth. A close-up showed the dolphin's heart, quite still. A ring of teeth enclosing a still heart, with a note of mourning: Violent death.

Again, the alien responded perfectly.

The bard was sure the alien had the idea, so he could go faster. A school of fish being chased by dolphins, followed by an abstract symbol and a note of excitement: Food! An empty stomach, followed by a symbol and yearning: Hunger. A beating heart, followed by a symbol and joy: Life. A child being born, raised to the surface, and suckled, then a symbol and deep contentment: Mother-love.

On and on the bard progressed, to deeper and deeper levels of abstraction, and the alien remembered everything perfectly. Of course it would; it was a bard.

By the time the morning sun started to scintillate from the surface of Our Mother, the bard was exhausted. Sleep, he told the alien, and swam wearily away, to a nearby shallow cove, where the water should get warm in the heat of the day.

* * *

(Hunger/necessity.)

The bard awoke; he had slept but briefly. Facing him, blocking off the mouth of the shallow cove, was a young bull Killer. The bard scanned, and recognized it as one from the great bull's pod.

(Anticipation of satiation.)

The bard started yelling for help, pitching his call in the lower registers, the frequencies that carry the farthest. He swam to the head of the bay until his belly was scraping bottom.

(Swim to me now, little one. There is no escape.) The Killer swam to within a few feet of the bard, and could come no further. (Clever, warm morsel, but Mother recedes. You will be left in the air, to die slowly. Why would you wish to die slowly? Swim to me now. I will be quick.)

The bard did not reply, but continued his broadcast for assistance.

(They are nowhere near. There is but thou and I.)

The bard had no wish to die, either quickly or slowly. Life was sweet, life was warm, life was full of mystery. There were too many questions unanswered; he had been so caught up in teaching the alien his language that, when the alien could have answered some questions, the bard was too tired to ask them. Life was just beginning.

The Killer was right: Mother was receding. Already he could feel the oysters beginning to cut his belly. Yet he could not swim toward the Killer; a slight dropoff permitted that creature to stay close. Desperately, he renewed his calls.

Now it was too late, even if help

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came. The bard was half exposed to the air; much of his weight rested on the oysters, which were cutting deeply into his flesh. To try to thrash his way to deeper water now would mean cutting his belly open; it would also give the Killer the satisfaction of a meal. He lay still, conserving his strength, but for one last call.

He was answered! The enormous bull came charging in from the Sound, roaring his fury. The young bull was trapped as the bard had been trapped, by the cove. The leader rammed the young bull at full speed, hitting him in the belly with such force that the young bull was lifted almost clear of the water. The injured Orca let out a howl of pain. The old bull scanned him; there was some internal bleeding, but the young one would live.

(Fool! Swimming stomach! Mind of a shark! Leave these waters! I will kill you if I see you again!)

The young Orca limped painfully away, and the old bull turned to the dolphin. (Bard, I am deeply sorry. Thou wilt surely die. Know that I mourn for thee.)

(No! There is hope!) The bard had been seized by an inspiration.

(Hope?) A dubious note.

Quickly, before the bard's head would be exposed to air, cutting off his communication, he told the old bull about the alien bard, who was connected in some mysterious way with the creatures who travelled in the monotonous dead shells.

(But there is no alien bard in these waters; surely I would know of it.)

(It is new, wise one, newer to these waters than I.)

(Even so, what could it do?)

(I do not know, but it is a clever creature. I have no other hope.)

(That is true, bard. I feel responsibility; I will do as you plead. Where does one find this creature?)

The bard barely managed to give his directions before his head was exposed, and the bull was gone. From a pain-filled eye, he saw a seagull land and cock its head inquiringly at him.

Marin came blearily into the screen room, coffee mug steaming in her hand.

"Ah, good morning!" said Bob. "I thought you'd never get up."

"Morning, Bob. Don't you know I can't stand good cheer this early in the day?" She yawned and plunked herself in a chair.

"Well, this should perk you up. Our friendly dolphin returned during the night, and gave me a long lesson in dolphin linguistics."

It did perk her up, so quickly that she spilled some coffee in her lap, causing her to curse. "Jesus! Why didn't you wake me up? What did you learn?"

"Patience, patience. I've got the whole thing stored in peripheral, of course; you can look at it any time. It really was fascinating. High level of abstraction, with some remarkable differences in mind-set. For example, they have absolutely no concept of geometry, which is only natural when you consider that they have never seen a straight line. But they do have a very highly evolved sense of the calculus of fluid motion."

"Hold on; stop. I'd better get Jeff, and then maybe we can view the whole encounter ourselves, start to finish. Conclusions we can leave until later."

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"Certainly, mem-sahib. Yes, wise one."

Marin padded out; shortly afterwards, she and Jeff came running into the room, in response to high-decibel shouts from Bob. "What is it?" they yelled.

"Oh," said Bob, "you're here. We have a visitor, an Orca. A very big Orca." The sonar screen was flickering wildly, with only the occasional image being visible.

"I think it's some kind of an emergency," said Bob. "The language has similarities to our friend's, but also some differences. I think he's saying that our friend is in trouble . . . hold on . . . he's stranded somewhere. That's it. He's beached, and in danger of dying. This Orca wants our help; he will guide us there."

"Oh, my God. Jeff! Run and get Les; tell him to warm up the outboard. Bob, tell the Orca we're coming, get him to wait for us."

Jeff was already gone; Marin ran into the kitchen, where Moonshine was rocking in her chair, smoking a pipe.

"Listen, Moonshine, this is an emergency. I need broad strips of something strong and flexible; let's see, about eight, maybe ten feet long."

Moonshine took her pipe out of her mouth, considered it. "Got a big sheet of good, thick leather. Was goin' to make Les a coat. Could cut some strips outa that. Have to be replaced, though."

"Perfect! Good! Four strips, as close to ten feet as you can get them, about ten inches wide. Okay? No time to explain. Sorry. Can you make it fast?"

"Sure, sure. Hurry too fast, you get nowhere, though."

Marin waited until Moonshine got out of the rocking chair and moving her version of fast, then ran out to the tool shed. There were a couple of old oars there. She tested them: still sound. Jeff appeared; she sent him to help Moonshine, then grabbed a hammer and pocketful of broad-headed boat-nails. She dragged the oars to the front yard and ran into the house.

Working with a hefty pair of leather scissors, Moonshine was cutting a spiral into the sheet. Two strips were ready; Marin took these to the front yard. She laid them on the ground and rolled one end of each around an oar, securing them by driving the boat-nails through the leather and into the wood. She thought for a moment, and decided to attach the other oar when they got to the dolphin.

Jeff appeared with the other strips; Moonshine was behind him, wearing a pair of hip-waders. "Dolphin stranded, eh? Gonna take four to lift it. I'm strong as hell," said Moonshine.

Marin smiled gratitude at her and attached the two remaining strips. She rolled all four strips around the oar, making a compact bundle. Jeff carrying the other oar, they walked quickly down the dock, where Les had the old outboard idling.

"That's a goddamn big Orca," he said. It was indeed a big Orca, Marin thought. The dorsal fin stood a good seven feet out of the water. You never saw them that big in captivity.

They cast off, and Les brought the ancient clinker-built lifeboat to speed, about ten knots. The Orca led, rolling majestically ahead of them.

During the trip, Marin had time to be amazed at what was happening, at the

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unlikely partnership, at the primal beauty of the scene. Gulls wheeled and cried around them, and as they rounded the point, they came under the stern gaze of an eagle that was perched on the topmost limb of a dead tree's skeleton.

They did not have far to go; the dolphin was only three coves away, stranded on an oyster beach about ten feet away from the water. A swarm of gulls, who had been eagerly attending the dolphin's funeral, lifted and screamed in frustration as the noisy boat hove into view.

Les brought the boat nosing to shore; Marin, Jeff and Moonshine leaped out with their makeshift stretcher. Les, mindful of the falling tide, backed the boat out to waist-deep water, dropped the anchor, and jumped out.

Jeff was first to reach the dolphin. He crouched beside it, crooning encouragement and stroking its beak. The dolphin moaned a chipmunk moan through its blowhole, its fixed grin rendered unlikely by the pain in its eyes.

"My God," said Marin. "It's cut pretty badly. Damn. We have to slip these middle strips under its belly, but we're going to be as gentle as possible. Jeff, when I give the word, I want you to lift his head. Moonshine, get on the other side; I'll feed this strip to you. Okay? Now." The dolphin screamed as its front half was elevated, and blood streamed from its belly, but it did not struggle.

"Good. Now the back half. Ready? Go." That accomplished, the outside strips were easier, and then it was a quick matter to attach the other oar, being careful to get the tension on each strip just right.

Together they lifted and struggled down the beach, resembling an ungainly eight-legged animal. The extra weight drove their feet ankle-deep into the mucky beach, and the clusters of oysters kept threatening to trip them, but they did not fall or allow the blood-streaming belly to scrape. When they were up to their waists in water, the dolphin was afloat.

"Keep holding him up," said Jeff. He submerged, and felt tenderly along the dolphin's underside, picking out pieces of broken-off shell. He reappeared on the surface, nodded. Gently, the harness was lowered; the dolphin moved slowly into the bay, leaving a red wake.

"Oh no," said Marin. "I should have thought of that. Swimming will open the wounds even more, and pump blood out of him. We've got to get him back to Cougar Bay somehow, re-rig this sling there, support him while he heals."

The Orca moved toward the dolphin, and submerged. He reappeared under the dolphin, and continued to rise until the Tursiops was draped over his back, in front of the enormous dorsal fin.

"Unreal," said Les. "I've seen them hold their babies like that."

The Orca was swimming slowly toward Cougar Bay; the humans clambered back into the lifeboat. They caught up with and passed the gently swimming bull with its precious burden.

By the time they docked, everyone had their instructions. Jeff ran up to the house to tell Bob what was going on, so that he in turn could elicit the cooperation of the Orca. Marin, Les, and Moonshine gathered materials.

Reassembled at the end of the dock, they nailed one of the oars across the

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ends of two beams. The other ends of the beams were spiked securely to the surface of the dock, so that they projected out over the water. The bull had arrived, and could be heard talking to Bob. Jeff stripped out of his wet clothes and jumped into the water.

The bull moved towards the jury-rigged cradle, then submerged, leaving the dolphin to swim the last few feet under its own power. When it was under the beams, Jeff passed the free oar under its body, and handed the oar up to the dock, where it was secured. The dolphin was suspended, only its blowhole clearing the surface. Jeff stayed in the water, murmuring to the dolphin, stroking it.

Marin sat happily down. "Well, there we go." She smiled, then frowned. "What am I talking about? I should contact the Vancouver Aquarium, find out what the medical procedures are for a case like this. They probably have antibiotics on hand." She hurried up the dock.

Les looked after her, shaking his head. "Nice woman, but she gets real speedy sometimes," he commented.

Moonshine nodded. "She gets things done though, I notice." Les looked uncomfortable. "I notice we only have about a half year's wood supply. Only a couple months left for drying."

"Yeah, yeah," said Les. "I'll get right on it."

Moonshine smiled, tousled his hair. "Bad old hippy," she said. "Wanna toke?"

Les brightened. "You know it, babe. You know it."

The great Orca surged mightily out of the water, its black back glistening in the sun, sounded, and was gone.

Night. Moonlight melting on water like oil. Sub-aqueous flashing of phosphorescence. Dialogue.

(These humans are intelligent?)

(They are.)

(Yet, they do not speak.)

(Not as you do, bard. I speak for them.)

(You. Your voice comes from dead things. Yet you live?)

A long pause. Then: (Yes, bard, I live.)

(I have much to learn.)

(As do we all.)

(Sing to me, strange creature, beautiful creature. Sing me to sleep.)

From beneath calm waters, the swelling strains of Pachelbel. ■

● Would any civilization with a superior technology wish to do harm to one that has just entered the community of intelligence? I doubt it. If I were looking through a microscope and saw a group of bacteria spell out, like a college band, "Please do not put iodine on this plate. We want to talk to you," my first inclination would certainly not be to rush the bacteria into a sterilizer.

Philip Morrison

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WHO WILL GUARD THE GUARDIANS?

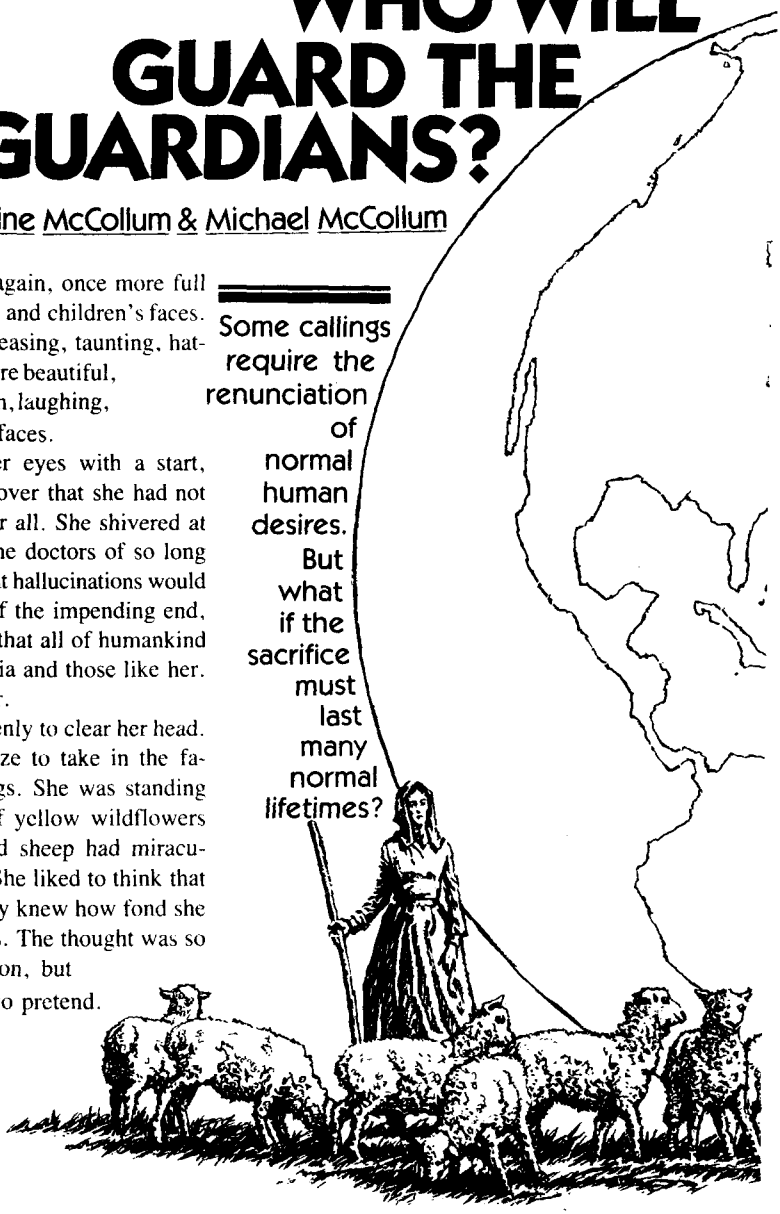
Catherine McCollum & Michael McCollum

The dream came again, once more full of greens and reds and children's faces. They were ugly, teasing, taunting, hating faces. They were beautiful, peaches-and-cream, laughing, shouting, joyous faces.

Fria opened her eyes with a start, frightened to discover that she had not been sleeping after all. She shivered at the realization. The doctors of so long ago had warned that hallucinations would be the first sign of the impending end, the first evidence that all of humankind is mortal, even Fria and those like her. Nothing is forever.

She stood suddenly to clear her head. She raised her gaze to take in the familiar surroundings. She was standing in a large field of yellow wildflowers that her goats and sheep had miraculously not eaten. She liked to think that it was because they knew how fond she was of her flowers. The thought was so much self-deception, but it comforted her to pretend.

Some callings require the renunciation of normal human desires. But what if the sacrifice must last many normal lifetimes?



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She hesitated briefly, listening to the faint hum of wild bees and the quiet whisper of the wind. She brushed at her long woolen skirt, dislodging some of the yellow pollen that clung to it. Then she turned and started up the long ridge that climbed to the top of her mountain. A dark shape burst from the underbrush to trot beside her. It was her dog, a nameless mongrel of uncertain parentage, one of her periodic houseguests who drifted into her life, stayed a few days or weeks or months, and then drifted out again.

She sighed and spoke for the first time in several hours. "Hopefully it is too late for her to come tonight. Help me gather in my sheep, and I'll share my supper with you." The dog's soulful brown eyes locked with her own, but he made no move to leave her side. Fria smiled indulgently. Between her few animals and small garden, most of her days were well filled. She reserved her nights for waiting . . . and dreaming.

By the time she had penned the sheep, milked her two goats, and shut the chickens inside the old shed, there were three dogs waiting by the front of her house. They were a thin and scraggly lot. One had half its ear gone and a long healed scar that crossed its muzzle on the diagonal, giving it a mean look that was belied by the wagging of its tail.

Dogs were not kept much as pets anymore, and had not been since The Destruction. That unhappy time had apparently severed the age-old bond between man and dog forever. Most strays that wandered into the village at the foot of her mountain ended up in the community stew pot. Except for a few relics such as herself, there was no one left to remember man's best friend. She noted with a pang that the collie mix among the strays was a pregnant bitch. Fria shivered beneath her woolen shirt, hoping that the dogs would be gone before the bitch's time came.

The stone house was cold. It was always cold. She didn't mind, for the cold was her preservative. As usual, what few furnishings she had were well hidden by the clutter—tattered and yellowing books, scattered sheets of foolscap with scrawls of lumpy, homemade ink on them, her lounging cats. Immediately her eyes sought out Pounce. The cat's tail could be seen protruding from beneath an impromptu tent of old magazines. Fria loved Pounce in spite of the cat's lazy, ungrateful attitude toward life. Pounce was her only link to the long-departed world of her youth.

"Here, Pounce!"

The tabby's head lifted slowly from the pile of magazines as though to reproach Fria for disturbing her sleep. Pounce yawned, seemed to debate with herself on whether getting up was worth the effort, and then stretched. She walked to the edge of Fria's ancient desk and waited. Fria scratched her behind the ears and after a moment or two was rewarded by a grudging purring.

"You're slowing down, Pounce. Can you finally be getting old after only 400 years?" She chuckled at her feeble joke, wondering what the villagers would say if they heard it. At the thought of the village and its inhabitants, the smile faded from her lips.

Fria did not tolerate people and allowed herself very little contact with others. She deemed the villagers irritating fools, and had little reason to be-

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lieve the rest of humanity was any better. Occasionally they would send pilgrims up the long trek to the mountain's top with offerings that she would grudgingly bless. Once, long ago, she had tried to help them. But the effort had been fruitless, and she had given up in disgust.

Like the houses of the village, her home was without electricity. This had not bothered her for a long time. One large room held a fireplace where she cooked and spent most of her time. A small bedroom in the rear was separated from the main room by a ragged woolen blanket hung from the ceiling. A sleeping loft completed her domicile.

Fria ate her meal sparingly and gave most of it to the dogs who waited patiently outside. After the collie mix had gulped down a bowl of curdled goat's milk, Fria found herself scratching the base of the bitch's ears. Fria could not figure out why she cared. Maybe it was because she remembered what dogs had been like before. . . .

She brought her thoughts back to the present with a start. She'd let her grasp on reality slip again. She knelt over the bitch, running her hand over its distended belly. A tiny lump moved beneath her fingers. She pulled her hand away as though it had rested on a hot stove. The sudden movement caused the collie to yelp and run for its companions.

"Sorry," Fria said, sighing. She turned to go inside and then glanced back at the dogs, tears welling in her eyes. "At least you have each other."

Fria's evenings were long and restless and sleep was hard to find. Sometimes at night she would sit by the fire and stir the coals, staring at the burning brightness until her eyes hurt. Fria's need for sleep had declined over the years, and what little rest she did get was more and more filled with endless nightmares. She would toss and struggle on her small straw bed until she was covered in cold, clammy perspiration.

Tonight she lay half-asleep on her bed. The long-dead faces were just beginning to form as the cold fear began to build inside. A dull thudding seemed to burst inside her head. She forced herself awake, bolting into a sitting position. The sudden movement made her dizzy. Fria sat at the dge of the bed, her hands pressed tightly to her head. The pounding noise refused to end. The barking of the dogs was undercut by a small, high, muffled voice that floated to her above the din. Slowly the fear began to dissipate into a paralyzing numbness.

Fria found the candle by her bed with trembling hands. She stumbled to the fireplace, where a red glow of dying embers still lingered. She bent over and touched the candle tip to the embers, being rewarded by a pale, yellow flame. The pounding at the door had become more insistent. Her heart thumped almost as loudly as the noise. She could feel her pulse in her throat as she pulled the door open. In the faint light she saw a frail little creature pushing awkwardly at the surrounding dogs.

"Get these animals away from me!" The wraith kicked at the dogs as it spoke.

Fria hesitated. Before she could respond, the figure pushed past her and deposited itself in front of the fireplace.

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Fria fought the wind and forced the door closed before turning. The figure removed its wet cloak, revealing a young girl with wet blond curls, a pale pinched face, and fair coloring. The girl dropped her cloak in a heap at her feet, turned, and stared at Fria as intensely as she was being stared at. Fria felt herself stiffen. The girl took a step closer, disbelief on her face as she lifted her hand to touch Fria's face.

"You're not old at all." Her laughter was a short, sharp bark. "Why, you aren't even as old as my mother!"

Fria pulled away and quickly brushed past. She placed the candle on the table and threw several logs on the fire. In seconds they had burst into yellow flame. She turned to the girl and pointed toward the fire.

"Stand in front of the hearth and remove your clothes." She didn't like the quaver that had crept into her voice.

The girl hesitated, her eyes wide with fear.

"Now!"

The girl walked across the room, through the clutter, and past emerald cats' eyes staring unblinking from the shadows. "This is where you live?"

Fria ignored the question and watched intently as the girl, her fingers numb with cold, struggled with her laces. After a moment she spoke: "What is your name?"

"Amber," the girl said as she halted the struggle with her wet clothes and smiled shyly at Fria. "I've come a long way. I'm cold and I'm hungry. Do you have anything to eat?"

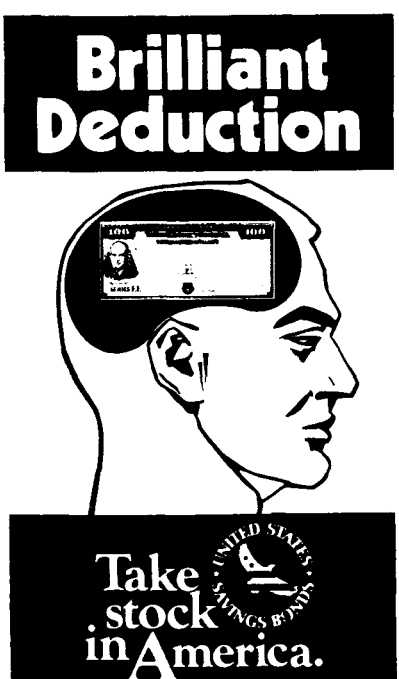
"Later, girl!"

"I'm awfully hungry. I stopped in the village. When I told them I was looking for you, they turned away." She hesitated as she noticed the flare of anger in Fria's eyes. She gulped loudly before continuing. "You were expecting me, weren't you? I mean, you knew I was coming? The elders said you knew!"

Fria nodded angrily. "I knew all about it. Stop dawdling and disrobe!"

Amber had removed her sodden dress and stood before Fria in a loose-fitting camisole. Her lower lip quivered and she shook her head in a curt negative. Fria lifted the candle to where it was even with Amber's eyes and leaned forward until their noses were mere inches apart.

"Now that you are here there can be



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no refusals. I must be absolutely sure. Your life depends on it."

The girl whimpered as she lifted the soaked camisole above her head. The firelight reflected off her body in flickering shadows. Fria grabbed the girl by the shoulders and spun her around. The tattoo was precisely where it should have been. The number bore the crisp, machine-produced look of an Examiner. No human hand could have forged it. And if that wasn't sufficient, the number tallied with the simple, unbreakable code that Fria had used when she had given out the chrome-and-steel Examiner boxes a dozen years earlier.

The girl had been rightfully chosen, rightfully marked.

After the verification was over, Fria stepped back and let her eyes rove over the rest of the girl's body. What she saw was a young girl on the verge of womanhood. The signs of incipient puberty were everywhere, from the slight swelling of the hips, to a hint of breasts to be. Fria let her eyes drop to the bare triangle between Amber's legs. She was reminded of another girl four centuries earlier who had shyly covered herself as other hard eyes had surveyed her.

She was reminded of what she had lost.

"Don't get dressed. Lay your clothing on the hearth to dry. You'll find a blanket to wrap yourself in up in the loft. After that, I'll give you food."

With that she turned her back as the girl followed her instructions. It wasn't until she heard the soft scrabbling of bare feet on straw in the loft that Fria began to shake.

Fria recognized that her mood would allow her no further sleep. She waited silently for Amber to eat her fill, then saw her bedded down. She waited until a quiet, regular breathing could be heard from the loft before wrapping a wool blanket tightly around her shoulders and stepping out into the moonlit night. The mountain air was cold—uncomfortably so, even for her—yet the tiny stabbing pain that accompanied each inhalation seemed to clear her head and calm her emotions.

She did not walk far. Four centuries of residence among the high crags had taught her feet the path to the outcropping of granite that overlooked her meadow of flowers. She was barely conscious of her progress or of the dark shadows of the dogs following closely behind.

Fria found her perch and pulled her knees to her chest, drawing the blanket about her. Below her, the field of flowers rippled eerily in the moonlight, as though it were some far sea whipped by storm winds. She lifted her eyes to the sky. The stars seemed steel hard points of radiance, as chilly as the wind around her. She was filled with sadness as she caught sight of a star that moved slowly from west to east in violation of nature's order.

There had been a time long ago when fathers held their children aloft and pointed out the moving lights that were the great space stations, the jumping-off places for the far planets. No longer. Now the sight of the sky derelicts only served to remind people of The Destruction. Few stargazed as a result.

Fria was different. She had long ago ceased to fear the sky. Now it held only a pleasant sadness for her, a wistfulness

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for that which might have been. The old memories spilled forth in abundance. In many ways they were clearer than those of the year just past. She shuddered at the thought. The ability to recall your childhood (but not your morning) was one of the first symptoms of creeping senility.

Her clearest early memories were of her father telling her stories of the time before The Troubles, the time when man's future had seemed unlimited, the time before the aliens came. In those days it had seemed as though humans had finally tamed their warlike nature as they spread throughout the solar system. Their settlements dotted the surface of Mars, the asteroid belt, and the moons of Jupiter and Saturn. Their mines scarred the surfaces of fiery Mercury and frigid Pluto. Their orbital cities grew rich and prosperous. Only the far stars were left for conquest.

Then the aliens had come.

Their interstellar ships were wolves among Earth's interplanetary sheep. Only when they came up against fixed planetary defenses did they show any vulnerability. Even then, however, humanity was able to achieve little better than a standoff. The best computers Earth possessed gave space-going civilization less than two centuries to live if nothing were done to change the odds.

Something was done. Human weapons research was easily on a par with that of the aliens. Only in the development of interstellar craft was mankind behind its tormentors. Humanity's leaders decreed a punitive expedition be launched to carry the battle to the aliens' home. The expedition would take nearly a a century to reach its destination. In order to provide the expedition with crewmembers, a crash program of research into drastically extending human life span was immediately begun.

The scientists worked for twenty years while *Starship Vengeance* was slowly assembled in orbit. A decade after Fria's birth, they found their answer. It was not a perfect answer, by any means. More than a million laboratory animals died in the experiments. But it was an answer . . . of sorts.

If the subject was female and on the verge of sexual maturity . . . if she possessed a rare factor in her blood . . . if these and a hundred other parameters were exactly right, then it was sometimes possible to extend life to half a thousand years or more. The first success had been Pounce the Cat, for a few years the most famous "person" on Earth.

Then had come the human volunteers. Grisly experiments established that the chances of success were less than one in a hundred. In the end, though, fifty little girls emerged from the treatment tanks after more than two years of therapy. Each was ready to take the war to the enemy.

The enemy never gave them that chance.

Fria fidgeted uncomfortably on the rocky ground. The dogs had wandered off to scavenge food for their ever-hungry bellies. A dim light in the east hinted at dawn. She would have to face the girl soon. She shut her eyes and tried to keep the memories from washing over her. The mere thought of Amber triggered a mental picture of herself at the same age. She had been so happy, so blissfully ignorant of the consequences of

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The Treatment. She had long since forgiven her parents. After all, how could they have known what immortality would be like? She couldn't very well blame the twelve-year-old Fria, either. That little girl had been far too young to have any real opinion in the matter. If only . . .

"No!" she yelled, as she forced herself to her feet. What was done was done, and wishing would not change it. She turned in the first, grey light of dawn and started back up the hill to her house. Amber would be waking shortly, and if her appetite of the previous evening was any indication, she would be wanting breakfast.

Fria stirred a boiling pot of corn meal and listened to the sounds of the various animal inhabitants of her mountain greeting the new day. Two bluejays fluttered through the trees in front of her house, chirping and scolding each other while an irrepressible rooster crowed from the roof of the shed out back. The porridge bubbled slowly in its kettle while flames crackled upwards against its black bottom. Beside the kettle an old, dirty teapot simmered with scalding brew.

Behind her Fria heard the sounds of stirring from the loft.

Fria straightened from her cooking and looked around for Pounce. Lately the cat spent more time than usual sleeping and she'd taken to curling up in unusual places. She hadn't eaten well the previous evening either, which was unlike her. In nearly forty decades of living with her, Fria had never known Pounce to willingly miss a meal.

Fria heard a creaking sound behind her. She turned and met Amber's gaze as the girl descended the ladder from the loft. Her pale bare feet descended each rung quickly. The corners of the girl's mouth curled upward in an eager smile framed in tight blonde ringlets where her hair had been disheveled by the rain. Fria looked quickly away.

"Good morning," said Amber.

Fria lifted the kettle from its hook over the fire, using a heavy rag to protect her hand. She placed it on the table and handed the girl a wooden bowl and spoon. "Eat your fill and feed the rest to the dogs." She didn't wait for an answer, but turned and walked brusquely outside. She stood for a moment and breathed deeply of the clear mountain air. The warmth of the sun's rays started to ebb the chill from Fria's body. She wondered what it would take to melt the chill in her heart.

She started walking slowly toward the goats' pens and was joined almost simultaneously by Amber and the dogs. Amber did not speak, and Fria was surprised by the girl's frightened expression as the dogs leaped and whined in joy around her. She bent and picked up a small rock, throwing it into a clump of bushes. The dogs ran like puppies to investigate. Fria turned to Amber, who was walking a step behind her. "The dogs are nothing to fear."

The girl shook her head. "I'm not afraid. But we never kept dogs. In fact I didn't think anybody kept them anymore. Except maybe to eat."

"There will be no eating of my dogs while I am alive. But enough of this foolishness. If you aren't going to finish breakfast, you can begin your work. The goats need milking, and after that there are other chores to do."

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Fria and the girl worked side by side, rarely speaking, until late morning. The sun showed it to be after ten o'clock when Fria gave Amber a basket and explained how to find the blueberry patch that was higher up the mountain. Two hours later, she was just finishing up her noon meal of reheated corn meal porridge, bread, and cheese when she heard the girl returning.

"What kept you?"

"I went for a walk after finishing with the berries."

"Don't make a habit of running off without telling me. You could be hurt and I wouldn't know where to look. Are you hungry?"

"I would rather talk. I have many questions."

"The elders told you all you need know."

"Please, there is so much more."

"There is, indeed," Fria said. "But what can I tell you that you are capable of understanding? Can one who has lived a mere dozen years truly understand what it is like to live centuries? Perhaps you think yourself able to comprehend the feelings of someone who has outlived everything they ever loved?"

"I can try!"

"You will fail. Look at yourself! You have the capacity within you to attain near-immortality and the prospect excites you more than you can say. You hunger for The Treatment, not even caring that it will subject you to nearly two years of torment."

"There will be pain?"

"Considerable. But the pain is transitory. You have something of far greater significance to fear."

"What could be worse than pain?"

"I suggest you spend the rest of the day thinking on that very question. If you wish to speak to me, I will be with my sheep."

The sky was a dull smoky color, full of heavy dark clouds. This and the cold stinging wind convinced Fria she could delay her return no longer. She had spent most of the afternoon trying not to think about Amber at all. Somtimes she had succeeded, but more often she hadn't.

Fria was barely conscious of walking the path to her home, or penning the goats and sheep, or closing the chickens into their coop. She moved through her nightly routine as though in a daze. She was roused from her stupor as a violent gust of wind pushed the door from her grasp and slammed it loudly against the wall. The fire in the fireplace shuddered and threatened to go out. A startled Amber dropped the spoon she had been using to stir the kettle. Ignoring the girl's fright, Fria pushed the door shut and secured it with a wooden bar. She lingered by the door for a few moments before turning to face the still-frightened girl.

Amber had returned to stirring the pot and was avoiding Fria's gaze.

Irritated, Fria spoke sharply. "What is it you're cooking?"

Amber's voice was barely audible when she answered: "Chicken stew."

Fria froze in place and did not speak. For some reason she couldn't put her finger on, Amber's trembling angered her.

"Are you upset about the chicken?" Amber asked.

"No, not about the chicken," Fria

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replied, making an effort to calm herself. "But from now on I'll decide the menu."

Amber laid the spoon down and turned with trembling lips to face Fria. In spite of her obvious fear, her eyes held a tiny spark of defiance in them. "You don't expect me to live on vegetables and cheese all the rest of my life, do you? I must have meat if I'm to receive The Treatment."

Fria turned her back on Amber, and grasped her hands tightly together to control their shaking. *Treatment*. God, how she hated that word! She was frightened now. She was afraid that if she turned around she wouldn't see Amber standing before the crackling fire, but rather that poor, sad little girl of four centuries earlier.

She fought to conquer the terrifying images that raced through her mind. Finally, when the old ghosts had receded a bit, she turned back to the sobbing girl. Fria gasped as she caught sight of Amber. The girl was seated on the hearth stone with Pounce's fur protruding from her enveloping arms. She was rocking back and forth and stroking the cat beneath its whiskery chin.

Amber glanced up, misinterpreted Fria's look, and smiled. "We made friends this afternoon when I was alone and frightened."

In that instant the pent-up anger of decades exploded within Fria. She found herself jealously grabbing Pounce. Not used to such mauling, the cat squalled and clawed and twisted frantically in Fria's arms. Unmindful of Pounce's struggles, Fria clung to the animal tightly. "Pounce is my cat! You are never to touch her again. Do you understand me?"

"You are the meanest person in the world!" Amber screamed. "They must have cut out your heart in order for you to live so long."

Fria took a step backward, surprised at the girl's outburst. Then she blinked, and as the words began to sink in, she laughed. It started as a deep-down, quiet chuckle and then built to a harsh cackle. Even to Fria the laugh seemed to contain more than a touch of insanity. Finally she collapsed onto a chair with tears streaming down her cheeks and got control of herself.

"Cut out my heart! Why, little girl, you'll find that's the least of what will happen to you when The Treatment begins. When I get through with you, you'll be just like me. You'll be an empty, barren, embittered old mule."

"No!" Amber screamed. She held her hands over her ears and bent her head almost to her lap. "I'll never be like you!"

Fria's hysteria stopped as quickly as it had come. She wiped the laugh-tears from her eyes and sat straight in her chair, regarding Amber with a new compassion. When she spoke, it was so softly that she wasn't even sure that Amber could hear her:

"Then you'd better leave now, before it's too late."

In one single motion, Amber was up and at the door. She tugged at the latch bar, pulled the door open, and ran sobbing out into the cold drizzle of the storm. After the girl had gone, Fria stood and walked to the open doorway. She stood and gently rocked the protesting cat in her arms for several min-

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utes while she gazed out into the blackness of the night.

Slowly Fria became aware of her surroundings.

She shook herself to come fully awake, suddenly realizing that she had never truly been asleep. Even so, she didn't remember descending the winding stairs that led from the trapdoor in her bedroom to the cavern buried deep inside her mountain. Nor did she remember seating herself at the main control console and energizing her ever-faithful machines.

The room was dimly lighted by blue electric lamps. The walls around her were lined with blinking, humming machines that talked to the giant computers buried deeper in the mountain. Directly in front of her, neatly displayed on her console, were a dozen tiny lights representing the Earth, the Moon, and the giant defense batteries that waited patiently for the command that would hurl destructive energies a million kilometers out into space.

Fria looked around at Command Center, truly seeing it in a way she had not in a long time. She remembered how it had been at first. In the first few decades of her stewardship, she had enjoyed coming down to look at the lights, the counterparts of which had gone out in the rest of the world. And, of course, she had come down frequently to check the screens for any sign that the aliens had returned. Not that it was truly necessary. The computers had suitable means for alerting her in the house above should they make new contact with humanity's foes.

But then as the empty years passed, as mankind sank ever further into the abyss of superstition and savagery, Command Center had become merely another harsh reminder of the past, and Fria had stopped coming.

Fria ran her hands absently over the cool surface of the screen before her, resting the tips of her fingers over the blinking, blue symbol that represented Earth. She sat there for a few moments, her mind numb. Strangely, she began to feel that this tiny pulsating light represented the beating hearts of all the people on Earth. She felt her face twist into a bitter smile as she realized how easy it would be to turn off that pulsing light forever.

Long ago, when the aliens had beaten mankind back from the depths of space, the great defense network in which she now sat had been all that stood between her people and destruction. The alien starships had massed for the last battle and thrown themselves against the ring of iron that surrounded Earth. They had broken against that ring. Later, when the world began to come apart at the seams, a few remaining defenders recognized that the threat was not over. Nowhere was it written that aliens might not return someday.

To guard against such a possibility, the world's last rulers decreed that fifty young girls would become the Earth's guardians. They who would never go into space would stand guard from hidden control centers buried deeply within and scattered widely across the face of the planet. Should the aliens return, the defense network would once again be used to repel them. But should the battle go badly, if it looked as though mankind would lose at last, the planners provided

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that the aliens' victory would be a Pyrrhic one.

Any Guardian had the capability to destroy the prize in order to deny it to humanity's enemies.

"So you thought of everything, did you?" Fria asked out loud, speaking to those long-dead men who had built the machines around her. As always, she was struck by the fact that Command Center allowed no echoes, but instead swallowed up her words. "You forgot that your immortals are only human, too. If only you knew how it feels to yearn for something you can never have, *and continue yearning for four hundred years!*"

When she volunteered for The Treatment, they had explained to her that there would be a minor side effect, a mere inconvenience. It would affect her glands, and as a result, render her infertile. Really, it was a very minor consequence when one considered that she was exchanging motherhood for "immortality." And she had accepted their words without a second thought. But as the long empty years passed, she found her desire for a child grew until it devoured her. She wanted to feel the rush of life within, to undergo the glorious pain of childbirth. She wished to feel that small child's hand trustingly encircled by her own, to watch it grow year by year.

She had made good progress in conquering the obsession over the last thirty or forty years. Yet the girl's arrival had stirred up the old urges stronger than ever.

"*Damn!*" She spoke aloud once more, slamming her hand hard against the monitor screen. "If only Amber had never come."

She buried her head in her arms and felt hot tears rolling down her cheeks. Slowly she became aware that the little blinking light she had been monitoring all these centuries was no longer there. For a moment she sat and stared at the dark space were Earth should be.

Panic gripped her and she raced across the room to the small back-up system behind the main console. Suddenly she was laughing and crying at the same time. She fell to her knees and did something she had not done in nearly three hundred years. She found herself mouthing a long-forgotten prayer of thanksgiving. The tears continued to roll freely down her cheeks.

For the blinking blue symbol with the tiny "E" inside it was still there. Now that her conscious mind was in control again, she realized that it could not have been otherwise. After all, if the Doomsday Device had been set off she would have had considerably more indication of that fact than the lack of the Earth symbol on the monitoring screen. It was only a minor malfunction brought about by her blow to the screen. The repair circuits were already working on it. There had never been any need for concern.

Yet it was her sudden concern that surprised her. She really did care! What happened to this ball of squabbling savages did matter to her. She felt an exhilarating feeling of relief surge threw her. After all these empty years she had a reminder that there was purpose to her life. Humanity was down, but not out. They would rise again. True, not in her lifetime. But perhaps in Amber's.

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The stars were still out there, waiting. They would not have to wait forever.

Fria did not know how long she stayed below after her revelation, but when she finally pushed back the trapdoor and climbed back into her own bedroom, she was surprised to see daylight softly shining in the window. For the first time in a long time she felt refreshed, as if she had finally achieved a long-needed sleep. She pulled the blanket partition aside and stood quietly. She was pleased to see Amber had returned and was apparently no worse for having spent the night in the storm. The girl was sitting in the middle of the main room with her back to Fria, holding something in her arms.

Fria hesitated, unsure of how to approach the girl. Finally, she walked forward and sank to her knees.

Amber had been crying. Her face was puffy and red. She looked up from the wet ball of fur that she cradled in her arms and began to sob at the sight of Fria.

"When I came back this morning, I found Pounce lying all stiff in the doorway. . . . I'm so sorry."

Fria gently took the cat from the girl's arm and placed it lovingly on the floor.

"It's all right. Don't cry. Please don't cry."

Amber sniffed back her tears and stared up at Fria with uncertainty and fear in her eyes. After a moment of hesitation, Fria reached out and took Amber's small hand in her own. She smiled reassuringly. Amber leaned forward and rested her head against Fria's shoulder. She felt the child's hand squeeze her own and she gently stroked the girl's soft curls. A smile played across her lips.

Maybe her prayers had been finally answered. Maybe, after all these years, she had a child of her own. ■

IN TIMES TO COME

● Science fiction mysteries are tricky to do, but when they're done right they're a special treat. In our November issue we have two, strikingly different from each other. The cover, by Vincent Di Fate, is for "Getting Even," Ray Brown's first cover story here. As you may by now expect of a Brown story, this one will keep you thinking even after you finish reading it, and you'll probably find a few new things if you read it again. The author claims he started out trying to concoct "the ultimate villain"; at the very least, he has a unique entry in the race.

Our other November mystery is "Rats in the Moon," by Pauline Ashwell, featuring her ungrammatical but remarkable heroine Lizzie Lee, whom you may remember from a couple of earlier stories here called "Unwillingly to School" and "The Lost Kafoozalum." She hasn't appeared here for quite a while, but she's still up to her old tricks.

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the reference library

By Tom Easton

The Transmigration of Timothy Archer, P.K. Dick, Timescape, $14.95, ? pp.
The Last Hero, Leslie Charteris, Ace Charter, $2.50, 311 pp.
The Blind Men and the Elephant, R.M. Griffin, Timescape, $2.75, ? pp.
Peace, G. Wolfe, Berkley, $2.25, 246 pp.
The Golden Naginata, J.A. Salmonson, Ace, $2.75, 310 pp.
The Rape of the Sun, I. Wallace, DAW, $2.95, 287 pp.
The Warlock Unlocked, C. Stasheff, Ace, $2.75, 282 pp.
The Pillars of Eternity, B.J. Bayley, DAW, $2.25, 159 pp.
They'd Rather Be Right, M. Clifton & F. Riley, Starblaze, $4.95, 174 pp.
New Dimensions 13, M. Randall, ed., Timescape, $3.50, ? pp.
Slow Sculpture, T. Sturgeon, Timescape, $2.95, ? pp.
A Reader's Guide to Fantasy, B. Searles, B. Meacham & M. Franklin, Avon, $2.95, 224 pp.

Philip K. (for Kindred) Dick, alias Horselover Fats, is dead. He died March 2, 1982, at the Western Medical Center in Santa Ana, California, after a brief illness.

So much is firm. So much is in the official Timescape press release, along with mention of five marriages, the two daughters and one son who survive the man, the 35 novels and six collections, the 1962 Hugo, and the 1974 Campbell Memorial Award. I must learn from *Locus* that the "brief illness" was a series of strokes.

We'll miss the man. He gave us many excellent tales, and if toward the end he seemed devoted to divine revelations via a beam of intelligent pink light, perhaps we can blame that on whatever factors were setting him up for the strokes. Perhaps so, though his latest books have borne no real stamp of madness. They have been strange, yes, but they have also been cogent and coherent, cries of

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anguish over the too-human condition. They have been works of art.

Dick's late concern with religion appears again in **The Transmigration of Timothy Archer**, his last book (unless another waits in manuscript). The story is science fiction only by courtesy, for one of its driving forces is the discovery of the Zadokite Documents, a repeat of sorts for the Dead Sea Scrolls. They suggest that Christ had antecedents centuries before his birth and that the Holy Spirit was originally a mere mushroom.

But let's not worry over whether the book is really SF. Isn't it enough that it's Dick's? That we can expect a serious, introspective tone? That we can expect great attention to character? Maybe so, though we should note that unlike Dick's other books, *Archer* lacks playfulness. Seriousness dominates until it becomes sententiousness, and even dreariness.

We should also note that the strong characters do not include the narrator, who exists solely as a pair of eyes to observe the book's focus: Bishop Archer, her father-in-law. Perhaps because of this the point of view becomes vague, unclear, when Dick strives to show the changes in Archer as he becomes lost in Christian novelty and obsessed with the ghost of his suicided son. But then this vagueness may be deliberate. There is a hint of this in the narrator's line: " 'I trust everything you utter. I am the perfect fool, come here to take. Give. Keep on with the sounds; it lulls me and I forget.' " The same line may comment on religions and their believers.

What else can I say? I think you now know enough about style and execution and even plot to decide to buy now, to wait for the paperback, or to let it pass. Should I add that Timothy Archer is a fictionalized version of California's late Bishop Pike? That he is a man of omnivorous intelligence, charismatic and compelling, a single-minded pursuer of knowledge confused by the search for truth? Does it matter?

I've mentioned the Saint in these pages before. I do it again because Ace Charter is kindly reissuing some of Leslie Charteris's novels once again, and they have given me the chance to plug one of the few remaining holes in my collection. I'm still missing *The Saint Meets the Tiger*, *The Saint Goes On* (my hardbound copy has one form doubled and one missing), and *Spanish for Fun*, but now I do have **The Last Hero** (a.k.a. *The Saint Closes the Case*).

Some of you know that the Saint, or Simon Templar, was a hybrid of Robin Hood and James Bond. He was an action-adventure, suspense-story, spy-tale hero who, outside the law himself, chased criminals with vigor, ingenuity, and humor. His influence has been wide. James Bond owed much to him. Algis Budrys's eyes light up at his mention. Many remember him fondly, and not from his TV incarnation, and may have modeled their own heroes on him, though never successfully. The imitations fail worst in the peculiar blend of action and ratiocination so typical of the Saint. They either offer too much of the latter element or ignore it completely. The Saint claimed to ignore it, but that was only his pose, and Charteris ratiocinated his plots as thoroughly as Carr or Christie. If he handed serendipity a lot of the credit, that was only an honest writer's humility, or a humble writer's honesty. Pick one.

Why bring the Saint into *Analog*'s pages? In his time, he met the standard, now clichéd, SF situations, such as the mad scientist with the beautiful daughter and the greenhouse full of giant ants. (Solution? Gasoline, if I recall aright.)

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In *The Last Hero*, it's the scientist who cares only for fame and is thus willing to unleash upon the world a dread new weapon. Mind you, this was in 1930, in the Saint's third appearance. World War II and Hiroshima were still years away. Relatively few people were even worrying about another Great War, but Charteris was one, and he stressed the need for watchfulness, for caution, even for ruthless, preemptive (one-man) strikes in tale after tale. In his time, Charteris was indubitably a writer of SF, and of social SF at that.

In *The Last Hero*, the mad scientist is being courted by the English government. At the same time, foreign agents are after the secret, and they will kidnap, torture, and kill to get it. However, the Saint witnesses a secret demonstration of the weapon and decides to step in to keep war sane, or as sane as hell can ever be (" 'Let men fight with the weapons of men, and not with the weapons of fiends' "—p. 232—). At the end, one of his sidekicks executes the madman.

It's a familiar plot. I told you so. But the ending is not. Our modern paranoia is greedier than Charteris's. And the execution is much superior to many more recent renditions of the theme. If you do not already know the Saint, or if you know him only from the tube, buy Ace's reprints. The headlong pace blurs the details of a bygone decade, and you will enjoy yourself as rarely before.

Russell M. Griffin's **The Blind Men and the Elephant** is a depressing tale. The title says much of it—there are distinct parallels between the novel and the fable of the blind men who argued over whether an elephant was more like a snake, a rope, a tree trunk, or a spear. Here the elephant is the Elephant Man, monstrously deformed, parentless, created in the lab from a cancer cell. One of his creators, upset that the baby is being treated as no more than a glob in a test tube, turns him over to a nun-run orphanage, home to other crippled, unwanted children. There he grows with the speed only a cancer knows until an "uncle" retrieves him for study as a potential weapon, as a vehicle for an infectious carcinogenic virus. He escapes, becomes a carnival exhibition, and falls into the lap of a fourth-rate TV weathercaster who sees in him wealth and fame.

The story brings all this out slowly, as events prompt the emergence of memory from a fog of TV soap. A name, MacDuff, emerges when the orphanage's Mother Superior appears on TV. A childhood and a history return, some of it progressively and spontaneously, more of it with a visit to the orphanage under mercenary tutelage.

The weathercaster is the story's narrator. He is a failure, but he is no more greedy, cruel, crude, and dumb than the other characters. He is a blot on the world, an excrescence, a cancer. So are all the rest, except MacDuff. He is gentle, forebearing, intelligent, a nice guy who belies his physical ugliness and his ugly origins. The contrast excruciatingly illuminates what we are willing to accept as normal, and it renders poignant MacDuff's ultimate tragedy—it is not enough that he die; he must also be immediately forgotten, and the weathercaster's casting off of venality must be stillborn.

Maybe I've told you too much. So be it. But this tale of one who is all things to all people in their blindness, and whose lasting impact on the blind is that of a candle, snuffed, cannot be adequately described in any other way. Do you want to read it? I don't know,

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though I suspect you *should* read it. It is depressing, yes, but it is also skillful and eloquent and heart-breaking. And it is far more plausible than Griffin's *Century's End*. *Do* read it.

We have yet a while to wait for volume 4 of Gene Wolfe's *Book of the New Sun*, and then we'll be able to look forward to volume 5, recently promised. For the moment, we can console ourselves with a reprint of his prize-winning **Peace**. It's billed as fantasy, but it is really neither that nor SF. Is it then mainstream? I suppose so, but I'm content to call it Wolfe's and note with a grin the way it foreshadows some elements of the pentalogy.

Peace is a memoir, penned by an elderly recluse who has wealth enough to have had constructed a house of many rooms, each room a replication of some scene of his life. There is his factory office, a childhood kitchen, and so on. There are so many that he can rarely find the one he wants and so contents himself with sitting by his fire, visiting the rooms within his mind and recording the events of his life. We have here the autarch's palace, the concern with rebirth and memory, with past loves and demons. We have the ornately rounded style, trimmed of antique vocabulary yet still satisfying. We have a life of everyday encounters with touches of the strange, but little so strange as to make us doubt its fundamental reality. Here is no fantasy, but one of us.

I'll give you no more. Let Wolfe do that. Only heed my promise that he will indeed, and buy the book. You can spend your money in no better way.

Now, let's see. This column will appear in the October issue, so you'll be able to enjoy *Peace* in the best of all possible ways and seasons. Buy it, save it for a cold and windy night, find a comfortable chair and a fireplace, and curl up. Such a setting and mood will mesh delightfully with Wolfe's story. Enjoy.

Jessica Amanda Salmonson has embarked on a pseudo-Japanese saga, the tale of Tomoe Gozen, woman samurai. *Tomoe Gozen* was volume 1. Now we have **The Golden Naginata**, and there surely will be more.

The saga is laid in a parallel world where the myth and legend of Japan are real, where magic works and spirits and demons plague the living. Tomoe Gozen is a woman sworn to honor, not love, and when her father tries to arrange a marriage, she flees, killing all who oppose her. Yet there are forces at work in her destiny, for the swordsmith Okio has been killed by a rival and his shade has summoned all who wear his swords to protect his family and avenge his death. The samurai gather, but too late. Okio's family is already carrion. They avenge, and Tomoe finds one of her allies is the man her father had chosen for her. They wed, and then they go to rescue the Emperor from his imprisonment by the Shogun.

Enough of the tale. There is plenty more, all of it imbued with a flavor no ignorant Westerner such as myself can say is not genuinely of Japan. It satisfies with charm, with action, with color, and with mystery. If magic were real, this would be no fantasy, but a historical novel, or even a history. And if that's your cup of saki, go to it.

Ian Wallace's **The Rape of the Sun** is pure Astounding Super Science. For love of his high priestess, alien Dhurk promises to fetch our solar system, suitably shrunken, as an adornment for her temple. On Earth, a team plans an array of power collectors in close solar orbit.

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As they assemble the mission team, they find a psychic who is attuned to Dhurk and whose reports explain certain strange phenomena. Later, while they are actually setting up the collectors, they are captured by Dhurk and must dissuade him from his mission.

Grand stuff, cut from the same fabric as those gleaming spacesuits of yore, but with more modern styling. If that's what you yearn for, help yourself.

Once upon a time (in 1969), Christopher Stasheff published a delightful tale, *The Warlock in Spite of Himself*, of science vs. magic, full of naughty-but-nice maidens who might turn themselves into mice and romp around under your clothes. *Very* titillating! He followed it quickly with *King Kobold*, which I never saw.

Now, after long silence, we have another sequel: **The Warlock Unlocked**. It's good. It's fun. But it isn't quite so delightful, and I suppose that's inevitable. You see, the weremouse maiden is a wife now, with a litter—er, excuse me, a *brood*—of kids who show a strange array of unusually strong magical powers, thanks to the genes of their daddy, the Warlock, Rod Gallowglass. Their world of Gramarye is still threatened by time-traveling anarchists and socialists and protected by Rod's parent outfit, true-blue democrats. The enemy is plotting to set Church against State; and to get Rod, with his gift for conciliation, out of the way, they set a trap that shunts him and his family into an alternate world. There Rod must vanquish wicked elves, a monster, and a usurper before he can return in the nick of time.

It's not quite as good as the original, but it is well done, wry, witty, and fun. Don't worry about being disappointed too badly. You won't be.

* * *

Barrington J. Bayley's **The Pillars of Eternity** stars a man who, as a waif, was used to test a prototype, artificial, information-processing skeleton. His new circuitry could boost his sensory acuity and make everything more vivid. However, when he encountered an alchemist's evocation of Hell, his advantages turned into a curse: even hellfire was intensified. Though he lived, linked for survival to a computer that must regulate every cell in his body, he bears a horrid, driving scar. He knows, the mathematicians have proven, that each cycle of the universe is an exact repeat of the last, and he *must* find some way to spare himself the torment on his next go-round. He hopes to find that way on the strange and ultra-technologized world of Meirjain, source of gems that reveal past and future, a planet wandering among the close-set stars of a dense cluster. Fortunately, Meirjain has just been rediscovered, and the chase is on. If the ending stresses the value of will over that of prophecy, that only makes the whole more satisfying in a hubristic way.

They'd Rather Be Right, by Mark Clifton and Frank Riley, is a long unavailable classic. Its premise is a machine that can make people immortal by stripping away their protective psychological armor, all the unrealities in their thinking, and hence their most cherished prejudices. It is therefore acceptable only to those who have so fallen that their armor has disintegrated, to the down and out, to the aged bums of Skid Row, and to the truly humble. The world's movers and shakers can neither accept nor use the machine. Anything but meek, they would indeed rather be right.

The book may in fact deserve its rep-

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utation. It *is* good. But once again I find Clifton given to stereotyped people, reactions, and attitudes. He seems simplistic and naive. Since he also seems just the sort of writer who belonged in Campbell's *Astounding/Analog*, and to a lesser extent in the present *Analog*, and since I hardly want to insult Stan or my fellow occupants of these pages, it may be worth suggesting that Clifton's stereotypes are stereotypes because his successors have borrowed them so often. Clifton himself supposedly drew his material from life, not from the fictions of others.

Too, *TRBR* was written in the McCarthy era. It's still relevant, but there's a vein of overstatement that marks it and many other anti-McCarthy works, a shrillness of paranoid hysteria. This alone may be enough to explain the apparent stereotyping as actual, political-cartoon caricature.

Terry Carr will have a run for his money with his next *Universe*. Last time I rated his selections more highly than those of Marta Randall in *New Dimensions 12*. Now, Marta Randall is sole editor, and the stories in **New Dimensions 13** are going to be hard to beat. Very hard. Michael Swanwick's "Trojan Horse" discusses personality rebuilding and an attempt to open up a godlike awareness. Charles Grant's "A Voice Not Heard" asks what effect seeing his true self would have on an artist. Daman Knight auffers an exercise in writing withaut *aus*. Molly Gloss's "Interlocking Pieces" confronts transplant donor and recipient. Howard Waldrop's "Flying Saucer Rock and Roll" is sheer delight, a singers' rumble with a surprise judge. Connie Willis's "All My Darling Daughters" is a cry of pain from the depths of prep school. Vonda McIntyre's "Superluminal," set in the "Aztecs" universe, deals with the role of perception in madness. There are more, but I thought six of the above worth recommending for a Nebula. They're that good. Don't miss.

Slow Sculpture is a new collection of excellent stories by Theodore Sturgeon. What more do you need to know? Which story is best? Perhaps the title tale, of cancer and bonsai and caring. Maybe it's "The Man Who Learned Loving," of sacrifice and salvation. Or "Uncle Fremmis," of the value of a swift kick in the. . . . Or "Occam's Scalpel," concerning, maybe, just why we have all that pollution. Or . . . Enough. They're all good, all marked by Sturgeon's patented empathy, the characters laid out in roes for your sharing. Highly recommended.

A Reader's Guide to Fantasy is a convenient and readable handbook for the novice. In an informal, appreciative way, it discourses upon authors, categories, series, prizes, and history. It's the perfect gift for that friend who says she'd love to try the stuff but can't guess where to begin.

And that's its function. Two of the authors run The Science Fiction Shop in New York, and the threesome also wrote *The Reader's Guide to Science Fiction*. ■

● The average man, who does not know what to do with his life, wants another which shall last forever.

Anatole France

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brass tacks

Dear Dr. Schmidt,

The arrival of another copy of *Analog* abruptly reminds me that I have yet to write in response to a point in John Gribbin's article, "Base Eight Arithmetic, Meteors and Man" (Dec. 7, 1982). This is the widespread belief—almost I wrote "myth"—that our decimal notation arose from counting on fingers. So many early SF heros confronted aliens with different numeration and numbers of digits that I suspect the belief arose here.

The Mayans and Gauls, who counted by twenties, might merely have used their toes too. (French still retains traces of this; "eighty" is *quatre-vingt*—four-score—and "20,000" leagues—*mille vingt*—is properly "a thousand-score" leagues.)

But how do you explain the peoples who came up with the duodecimal system of counting? Traces of this still remain in our own culture; eggs and oysters as well as cousins are reckoned up by dozens. But the big puzzler is the Babylonians, who seem to have had sixty digits to count on. (We still divide a circle into 360 degrees and hours into sixty minutes.)

No—even to a casually educated reader like me, it's reasonably well known that the decimal system arose from the abacus. Mind you, the Egyptians were using the forerunners of the "Roman" numerals very long ago, and these clearly *are* based on fingers. But ten coincidentally happens to be the number of beads it is convenient to string on a given column in an abacus. Twelve's a little bulky, makes the device a little clumsy to handle, though better than ten because it can be quartered. Nine or eleven might be as convenient as ten—nine maybe more so—but these are odd numbers. Eight is nice, better than ten because it too can be

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quartered—but counting by eights is so *slow*. Remember, they counted by transferring whole columns of beads at a swoop.

I don't say it's *purely* a coincidence, since the decimal notation in a very clumsy form was already in existence where the abacus arose. But if our hands had been of such a shape and size as to make twelve more "handy" for us than ten, we'd now be using a duodecimal system. At least, so I believe.

Incidentally, it's often said that arithmetic got its start when the Hindus invented a symbol for zero—a space holder showing an empty column of beads. Yes—but surely the essential invention was that of a *single* character for each of the numbers from 0 through 9. Roman numerals, even with a zero to help, would hardly give us much play for arithmetic to develop.

As with most things I think I know, I'm prepared to be shown to be wrong in this. But anyone who does—please do tell me how many digits the Babylonians had.

ROB CHILSON

Dear Editor:

Why do some authors invent unpronounceable names? I'm talking about Donald Kingsbury's *Courtship Rite* now, although this is not the first (Frank Herbert's "Dune" stories had their share, for another example). My problem is that whenever I come to a name I can't pronounce, that distracts my attention from the story line, and nags at me for hours. How do you pronounce Mnankrei? Is the M silent, or is it pronounced Um or Muh? Is that M-nan-kree-i, or M-nang-kree, or M-nank-ree? If he has to use such oddball spellings, he could at least give us a set of rules for pronunciation. And that's just one of the unpronounceable words in the story!

During the Vietnam affair, there was a name that no one seemed to know how to pronounce. The president of South Vietnam was Nguyen Kao Ky (remember?). The newscasters who made a stab at pronouncing his name usually said N-guy-en (as in Guys and Dolls). Then my wife's brother returned from service in Vietnam with his version of that name. He said Nigh-gen (or "Naggin"). Now I have become acquainted with a Vietnamese named Huyen Nguyen, and I now know that the correct pronunciation is "Nwinn," and his first name is pronounced "When."

So even here on Earth, if you don't know the rules, you have difficulties in pronouncing foreign names. I suggest that, if an author can't invent names that can conform to the human speech apparatus, he should hire someone who can. And if the pronunciation is ambiguous, he could at least tell us how he sub-vocalizes the name to himself when he is writing the story. What does he call Hoemei? Ho-may? Or Ho-a-may-ee? How about Hoy-my? And is the "th" in Liethe pronounced as in "the," or as in "think"? Is the combination "ie" pronounced as in "believe," or as in "lie"?

Frustratedly,

BEN JOHNSON

213 Coventry Drive
Campbell, CA 95008

Would you believe an alien named Johnson, or even a Roman emperor named Schultz? An alien or far-future story populated by names fitting neatly into our current local spelling system would be very unrealistic indeed. In the particular case of Courtship Rite, *the names* do *conform to the human speech apparatus, just as Vietnamese or Polish ones do. And it really doesn't matter whether your pronunciation is the same as the author's—all you have to do is*

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look at each name, pick some plausible pronunciation, and stick to it. (You might also bear in mind that the main reason the pronunciations seem ambiguous is that English has one of the least systematic "systems" of spelling and pronunciation in the world!)

Dear Stanley,

Excuse the familiarity, but as an old reader of *Analog* (since '32), all its editors loom in my mind as friends—even if I did manage to miss you in the crush at Noreascon II.

I'm not an addicted letterhack, my last missive to *ASF* being in April 1948. However, right now seems an excellent time to beg your assistance with two projects.

As you will know, I have just collaborated with Mike Ashley on the *Complete Index to Astounding/Analog*, published in a limited hardcover edition by Robert Weinberg in the U.S.A. A review copy will doubtless have reached you long before this. From Mike's "Foreword," you will notice he mentions that my collection—which we leaned on heavily—only goes back to 1935. (In a fit of madness I sold off my 1932–34 copies.)

So, Project 1. Can any reader assist me in obtaining any or all of those pre-'35 copies? I can't pay scalpers' prices, but I can offer *very* generous trade terms for mint current paperback and hardcover titles.

Project 2 is more ambitious, but links with Project 1. I now contemplate a complete photographic index of all the covers of *ASF/Astounding* since No. 1. For openers, this is purely for my own personal delight . . . but who knows where it may lead? Anyway, if anyone can help me with photographs (or in the U.K., access to copies to take pictures of them), I'd appreciate their contacting me.

Meanwhile, in anticipation of a further fifty happy years.

TERRY JEEVES

230 Bannerdale Rd.
Sheffield S119FE
England

Dear Mr. Schmidt,

One of your reflections in the March 29 issue begs comment.

I am fully in agreement re: idiot lights. I, too, prefer to read a gauge which will tell me when trouble is brewing rather than have a red light tell me it's already too late.

However, that's not really the comment I want to make. Instead, I address myself to the subject of visuals in general. Idiot lights in cars are but one manifestation; the new universal highway signs and the pictographs on such as rest-room doors are perhaps better examples of the art.

I'm told that this all originated in Europe, where a bunch of countries with umpteen languages crowd more people than we have here in *English-speaking* North America into a much smaller area. Back when only the really affluent did much travelling, and such mobility wasn't even imagined by the common folk, crossing language barriers was hardly a pressing problem for the masses. But times change. People move about more. Greater numbers of people, few fluent in their neighbors' tongues, are crossing national and language barriers daily, and inability to grasp quickly the meaning of a roadside side has become a problem. Hence, universal pictographs.

When tourist travel across the Atlantic was primarily eastbound, this became a great convenience to North Americans just as to nearby neighbors.

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Now our economic plight makes westbound tourism very attractive, so universal pictographs have found their way here. Very handy, too, for many of our own people here in North America who now cross language barriers, e.g. Mexico and Quebec, more frequently—both ways.

But you're still right: idiot lights are for idiots.

M.B. MONAHAN

320 Pleasant St.
Paxton, MA 01612

Yes, I know the rationale for the pictographs, and I agree that they're convenient for travelers who don't know the local language (though I also think travelers should make it their business to learn *at least the everyday essentials of the local language). The fact remains that they are a poor substitute for* words which are understood. *Why not put* both *on the sign? (Incidentally, I can imagine cases where a traveler from a* really *foreign culture could be thrown by some of the pictographs—like the ones on rest room doors. My brother was once refused admission to a restaurant somewhere in the South Pacific because he didn't have a skirt. . . .*

Since that editorial, by the way, I've heard of a new height of idiot light idiocy. A reader tells me he was recently taught to drive in a car with an idiot light for fuel!

Brass Tacks:
(re: Norman McKinney letter, 1/4/82 issue)

You have an interesting theory concerning money. In fact, when I have served as a guest lecturer at our schools I used this idea as shock treatment, explaining how a closed society may solve its inflation by discarding money and going back to the barter system.

Robert Heinlein also uses this theme in some of his "Smith" novels. You might check them out.

Back to the subject of money: before you can make any judgement on the use or nonuse, the function of it is most important. Money is three things: medium of exchange, measure of value, and storehouse of value. If you destroy money, you lead back to the barter to survive, and possessions become the valuation.

Money came about because of the need for something more functional than the above "barter, valuation, etc." In its true form, there is nothing wrong with money.

The villain in this script is the government's free-wheeling creation of money in excess of income, and most important—increases faster than the GNP. Creation of money through the Federal Reserve system and/or government is necessary. However, the fallacy of our government's policy to be all things to everyone has created the monster that the present administration is trying to correct.

Another important factor in this spiraling inflation is the lack of simple economic education in our schools. Very few people, including some college graduates, understand the use of money and its functions. More intelligent understanding can do much to correct the trend, because the voter would then know the difference between the ballyhoo of the candidate—especially when he promises something for nothing. Economics should be a required subject in schools—for sake of survival!

Finally, a perfect solution . . . the supply of money should equal the GNP, and no deficits be permitted unless strictly for emergency. And don't let the Senate decide what is an emergency!

BILL WESTRUP

Downers Grove, IL ■

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AGENTS WANTED NOW! Big money in Mail Order Books. Details $1. Mail Order Opportunities, A-10, P.O. Box 378, St. Cloud, FL 32769-0378.

SINCERE BOOK SALES AGENTS WANTED NOW! Part-time or Full. Do not confuse with usual worn-out offers. No experience needed. Full details, send $1.00 to: Five Lakes Enterprises, 6626 18 Ave. 30A, Kenosha, Wisconsin 53140.

AUTO PARTS & ACCESSORIES

AMAZING 200 MPG CARBURETOR. Fact or fiction. Full details $1.00: J. M. Enterprises, Box 5641B, Fort Lauderdale, Fla. 33310.

AUTOMOBILES & MIDGET CARS

200 MPG Carburetor Fact/Fiction? Did someone achieve it? Was the invention bought out? Write! MPG-DPC1082, Box 2133, Sandusky, OH 44870.

AUTHOR'S SERVICE

MANUSCRIPTS SELL when written after reading book: "What To Write/How To Sell It." Rent 60 days, $4.95. Purchase, $7. Alan Farrant, 1202 Blair South Pasadena, CA 91030.

AVIATION

ANTIGRAVITY PROPULSION DEVICE! Free Brochure. RDA 873, Concord, NC 28025.

BOOKS & PERIODICALS

THE LAST PLACE ON EARTH - Book Locator Service - If we don't have it? 1-702-456-5575.

ANALOG, Asimov, Astounding, Galaxy, Weird Tales, etc. Back Issues at Reasonable Prices. Free Catalog. Collections also purchased. Ray Bowman, Box 5845A, Toledo, Ohio 43613.

WORLDWIDE MAIL ORDER. Our quarterly catalogues update our virtually complete stock of SF and Fantasy hardcovers and paperbacks. Catalogue listing free US/Canada: $1.00 all other. THE SCIENCE FICTION SHOP, 56 EIGHTH AVENUE, NEW YORK, NY 10014.

CONFRONTATION IN SPACE: G. Harry Stine's pioneering work on space warfare. $6.95 + $1.50 Postage. Free Catalog. D.P.E. Co., 4 Cottonwood Lane, Seal Beach, CA 90740.

JESUS FICTIONAL! Positive proof Flavius Josephus created Jesus, authored Gospels. Learn leadership's secret! Booklet: $3.00 — Vecter, Box 6215, Bellevue, WA 98007.

SF — Fantasy Magazines, Books (New and Used). 64 page catalog $1.00. Collections purchased. R. Madle, 4406 Bestor Drive, Rockville, MD 20853.

DREAM LEGIONS MAILORDER—New/used speculative fiction paperbacks. Back issue digest and pulps. Large selection. 10% off new paperbacks. Worldwide service. Send for free catalog ($1.00 overseas) to: 3916 LaJolla Dr., LaJolla, Calif. 92037.

FREE BOOK Moneymaking Opportunities. Limited Supply available. Rush $1.00 for handling and postage: Nora Nembhard Co., Box 519Co, Stone Ridge, N.Y. 12484.

SCIENTIFIC, HISTORICAL ACCURACY OF BIBLE: Evidences from science, ancient manuscripts, archaeology. New Booklet, $3.25. P.O. Box 487, Richland, WA 99352.

SINCERE Book sales agents wanted now! Part-time or full. Do not confuse with usual worn-out offers. No experience needed. Act Now! Full details send $1.00 to: Greater Pacific Marketing, Box 290-2E10, Lebanon, OR 97355.

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BUSINESS OPPORTUNITIES

STAY HOME! EARN BIG MONEY addressing envelopes. Genuine offer 10¢. Lindco, 3636-DA, Peterson, Chicago 60659.

FREE BOOK — "2042 Unique, Proven Enterprises." Fabulous "Little Knowns. How tiny projects made big money! Work home! Haylings-OP, Carlsbad, CA 92008.

GOOD MONEY! Weekly! Processing Mail! Free Supplies, Postage! Information? Rush stamped envelope! Foodmaster-DC3, Burnt Hills, NY 12027.

BIG PROFIT HOME BUSINESS bronzing and chinakoting baby shoes. Cost $1.00 pair; Sells $19.95, up. NBSDG, 398 Airport, Sebring, FL 33870.

MAKE $100 DAILY WHOLESALING! 2500 below wholesale products. Spectacular home business. FREE DETAILS! Wholesaler, 7513-IO Rock Street, Cnarleston, SC 29405.

BE your own boss. Guaranteed. Free details. Rush stamped envelope. Bright, Box 742, Elmhurst, IL 60126.

ASSEMBLE profitable devices at home. Exceptional opportunities without investment. Write-for-full details now: Enterprises, 1133-IO Linwood Place, Utica, N.Y. 13501.

$600 Weekly. Home Mailing Program. Goodworld, Box 26233-JIC, Tamarac, FL 33320.

BECOME a wholesaler. No investments. We supply everything. Free information. Joseph's Wholesalers, Rt 2, Box K266A, Dept. DP-1, Thibodaux, LA 70301.

NEED extra cash? Sales book agent wanted. No experience needed. PT-FT Don't delay. Details, send $2.00 to: MB Enterprises, 408 13th Street, Box #259 Oakland, CA 94621.

BUY IT WHOLESALE

400,000 BARGAINS Below Wholesale! Many Free! Liquidations . . . Closeouts . . . Job Lots . . . Single Samples. Free Details. Worldwide Bargainhunters, Box 730-IO, Holland, MI 49423.

FLEA MARKET SUPPLY DIRECTORY. Buy where the Pro's buy! Below wholesale, wholesale sources. $2.00, Clifford, Box 128E, Olyphant, PA 18447.

UNLIMITED income selling quality costume jewelry. Catalog $1.00 (refundable). Free opal ring with first order. International Wholesalers, Box 7133-IO, Riverside, California 92513.

EDUCATION & INSTRUCTION

LEAD into Gold. Hoax? Send $10.95 for a report to: Arid Zone Information Exchange, P.O. Box 41630-G, Phoenix, Arizona 85080.

EDUCATION & INSTRUCTION — Cont'd

UNIVERSITY DEGREES BY MAIL! Bachelors, Masters, Ph.D.'s . . . without attending classes! Inexpensive, fast. Free revealing details. Counseling, Box 389-AN-10, Tusin, CA 92680.

EMPLOYMENT INFORMATION

NEW JOBS OVERSEAS! Top Dollars ($20,000 to $62,000)! Exciting Opportunities (short term or permanent) . . . Fascinating people & places! Call Anita Lucas, 312-274-9600 Ext. 404.

FILM & TV SCRIPTS

WRITERS AND COLLECTORS. Over 700 movie and television shooting scripts! Hitchcock to Spielberg. Send $1.00 for Catalog. Scriptfinders, 1626 N. Wilcox, Hollywood, CA 90028. Suite #348.

GIFTS THAT PLEASE

FANTASY FIGURE-LITES in three favorite Sci-Fi characters for that extra special gift or personal treat. Free details. The Mud Hut, 15115 Grant, Dolton, IL 60419.

GOVERNMENT SURPLUS

GOVERNMENT Surplus. Pants $1.00; Shirts $1.00; Shoes $6.00. Send $4.00 for catalog, refundable on first order, to LAWTON SURPLUS, 1806 Lee Blvd., Lawton, OK 73501.

HOBBIES & COLLECTIONS

GREAT RADIO PROGRAMS—mystery, adventure, science-fiction. Free list cassettes. Rare Radio, Box 117, Sunland, CA 91040.

SPACE PROGRAM collectibles, Mercury to Shuttle, Picture sets, postcards, emblems, medals, decals, etc. Spaceland Enterprises, Box 775-A, Merritt Island, FL 32952.

ADOPT an Urchin. Have a Heart. Little Urchin Ernie. Cretaceous Echnoid Pet Fossil. $3.50. 325 Goldfinch, Fort Worth, Texas 76108.

HYPNOTISM

FREE Catalog. Hypnotism, Hypnotic cassettes, sleep learning. Become the person you truly want to be. DLMH, Box 487, Anaheim, CA 92805.

IMPORT-EXPORT

MARKET 2500 "Amazing" New Fast-Sellers Without Risk. Giftwares, Decorative Accessories, Household Furnishings. Free Brochures! Ballrightco, Box 91309-N10, Cleveland, Ohio 44101.

JEWELRY

CLOSEOUT JEWELRY. 55¢ Dozen. 25¢ gets catalog. ROUSSELS, 107-310 Dow, Arlington, MA 02174.

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LOANS BY MAIL

GET cash grants—from Government. (Never repay.) Also, cash loans available. All ages eligible. Complete information, $2 (refundable). Surplus Funds-DG, 1629 K St., Washington, DC 20006.

QUICK MAILOANS! FREE APPLICATION FORM AND COMPLETE DETAILS RUSHED IMMEDIATELY!: Lenco, Box 724-W22, McMinnville, Oregon 97128.

BORROW $1,000-$50,000 secretly — "overnight." Anyone! Credit unimportant. Repay anytime. Incredibly low interest. No interviews, collateral, cosigners. Unique "Financier's Plan." Full information, $2 (refundable). Spectrum, 12 Wall St.-16, NY 10005.

MONEY PROBLEMS? Write us. Immediate Loans and Outright Grants to individuals refused elsewhere. 98% eligible! Associates, Box 98-D2, Brooklyn, NY 11235.

THE ARABS HAVE MILLIONS to loan! $25,000—$10,000,000 Possible! FREE DETAILS! Arab-DC, 935 Main, Vidor, TX 77662.

BORROW $25,000 "OVERNIGHT." Any purpose. Keep indefinitely! Free Report reveals little-known sources/techniques! Success Research, Box 29070-SW Indianapolis, IN 46229.

BORROW $30,000 without interest! All eligible. Repay anytime. Free details. Infohouse, Box 1004-AN10, New York, NY 10003.

VISA/Mastercard by Mail! Obtain one through us, not just information, but a service. Write! Credit-DPC1082, Box 2298, Sandusky, OH 44870.

BORROW By Mail! Signature Loans, No Collateral! Many more unique services available. Write! Free Details! MBG-DPC1082, Box 2298, Sandusky, OH 44870.

MAILORDER OPPORTUNITIES

FULL or part time, sell books by mail. Millions of potential buyers. Send $1.00 to Book Mart Co., 1025 Jefferson St., Suite 178, Santa Clara, CA 95050.

MEMORY IMPROVEMENT

INSTANT MEMORY . . . NEW WAY TO REMEMBER. No memorization. Release your PHOTOGRAPHIC memory. Stop forgetting! FREE information. Institute of Advanced Thinking, 845DP ViaLapaz, Pacific Palisades, CA 90272.

MISCELLANEOUS

DEBT relief instantly, legally, without bankruptcy! Stop creditor harassment wage garnishments, repossessions, foreclosures. Restore credit! Free details. Dynamoney, Box 33014(D), Decatur, Georgia 30033.

MISCELLANEOUS—Cont'd

COLLEGE STUDENTS! — Improve your grades — Termpaper catalog — 306 pages — 10,278 topics — Rush $1.00 — Research, Box 25097P, Los Angeles, 90025. (213) 477-8226.

OLDTIME radio programs. Suspense, drama, science fiction, comedies. Highly enjoyable tapes. Free catalogue. Carl D. Froelich, Route One, New Freedom, Pennsylvania 17349.

SAVE! Fabulous Natural Gems For Jewelry. Collecting! Gorgeous Amethysts, Tourmalines, Sapphires! Information Free. W. Taylor Gemcutter, 113-A Martin, Indian Harbor Beach, FL 32937.

UFO PHOTOGRAPHS Now available. Astonishing photos incredibly authentic in appearance. Amazingly realistic. Send $4.99 per set to AEROIMAGE, P.O. Box 1324, Puyallup, WA 98371.

SURREALISTIC ART POSTERS by Tito Salomoni—seen on the covers of s.f. books, and magazine covers. Write for free color catalog, Prestige Galleries, dept. A, 3909 West Howard, Skokie, Illinois 60076.

MONEYMAKING OPPORTUNITIES

$300 WEEKLY SPARE TIME — MAILING Salesletters. Details: Delta: Dept.-D, Box 2902-CRS, Rock Hill, SC 29730.

CLOSEOUT JEWELY. 55¢ dozen. (Catalog 25¢). ROUSSELS, 107-911 Dow, Arlington, MA 02174.

MAKE YOUR CLASSIFIED AD PAY. Get "How to Write A Classified Ad That Pulls." Includes certificate worth $2.00 towards a classified ad in this publication. Send $1.75 (includes postage) to R.S. Wayner, Davis Publications, Inc., Dept. CL, 380 Lexington Ave., New York, NY 10017.

$1000 WEEKLY POSSIBLE Mailing Envelopes! Easy Guaranteed Program! Free Details: Majestic, Box 415-DL, Lewiston, NY 14092.

$60.00 per Hundred securing-stuffing envelopes from home. Offer-details: Rush stamped self-addressed envelope. Imperial, P-460, X17410, Fort Lauderdale, FL 33318.

$500+ WEEKLY in spare time; easy, guaranteed. Start immediately! Free details. Box 6946-D, Chicago, IL 60680-6946.

MAKE HUNDREDS in spare time. Money received by mail. $3 buys report. Send to: Money, P.O. Box 81, Chilton, Wis. 53014.

FOR FAST BIG PROFITS sell how to make money books by mail. Unusual opportunity. Details $1.00: Claud Bryant, B9, 431 South Street, Crestline, Ohio 44827.

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MONEYMAKING OPPORTUNITIES—Cont'd

$500 Weekly possible! Commission mailing program. Work at home offer. Free Details. Pioneer Assocciates, Box 986(DA), Tualatin, OR 97062.

SELL Books by Mail! Big Profits! Learn what the mailorder business is about. Write Now! MPG-DPC1082, Box 2133, Sandusky, OH 44870.

A Gold Mine in classified ads. Good money at home, we show you. $5.95 Allen Martin, Box 187, 781 West Oakland Fort Lauderdale, FL 33311. Money Back Guarantee.

400% profit three-five years! Proven "safe" investment! Minimum capital-up! Details: Sase, John Plumb, 1634-C3, South 19th Street, Sheboygan, Wis. 53081.

PERSONAL

BEAUTIES worldwide want to hear from you! All ages! Inter-Pacific, Box 304-DT, Birmingham, Michigan 48012.

ISAAC ASIMOV's SCIENCE FICTION MAGAZINE, published monthly. Send $19.50 for 13 issues (includes shipping & postage) to Isaac Asimov's Science Fiction Magazine, P.O. Box 1855 G.P.O., New York, NY 10001.

SCANDINAVIAN Ladies, 18-68, sincere, seek correspondence, friendship, marriage. Details: Scannaclub, Dept. CO3, POB 4, Pittsford, NY 14534. (Please enclose stamp).

SINGLE? Widowed? Divorced? Nationwide introductions! Hundreds of sincere members! All Ages! Free information! Write: Identity, Box 315-DT, Royal Oak, Michigan 48068.

BECOME A Legally Ordained Minister. Free Details! For further information on how you can benefit: ULC-DPC1082, Box 2133, Sandusky, Ohio 44870

SINGLE? Meet that special person—anywhere! Very low fees. DATELINE, 316 Fifth Ave., New York 10001, (212) 889-3230 or (312) 523-2100 or (213) 854-0640.

UNIVERSITY DEGREES BY MAIL. Bachelors, Masters, Ph.D.'s . . . without attending classes! Inexpensive, fast. Free revealing details. Counseling, Box 389-DP10, Tustin, California 92680.

DELIGHTFUL Asian girl pen pals. Details, photos send stamp: Yumifriends, Dept. C, P.O. Box 5657, Berkeley, CA 94705.

ORIENTAL Ladies want to write you. Cherry Blossoms, Box 1021-DAV, Honokaa, Hawaii 96727.

RADIO & TELEVISION

CABLE TV DESCRAMBLERS and CONVERTERS. PLANS and PARTS. Build or Buy. For information send $2.00. C&D Electronics, P.O. Box 21, Jenison, MI 49428.

"STATUES"—a thrilling tale of horor. Order cassette tapes. Send $4.50 to After Sunset Recordings, 4820 Humber Drive, Nashville, Tennessee 37211.

RECORD & SOUND EQUIPMENT

FREE Promotional albums, concert tickets, stereos, etc. Information: Barry Publications, 477 82nd Street, Brooklyn, NY 11209.

SONGWRITERS

POEMS WANTED. Songs recorded and published. Radio-TV promotions. Broadway Music Productions, Box 7438-DA, Sarasota, FL 33578.

SONGWRITERS: Exciting offer! Poems, songs needed. Free evaluation. Creative Music Productions, Box 1943-A10, Houston, TX 77001.

SONGWRITERS. The Guild was organized 28 years ago to help writers produce good songs and sell them. National Songwriters Guild, 2421 Walnut Rd., Pontiac, MI 48057.

SPECIAL SERVICES

ASTROLOGICAL CHART. Planet positions at Birth. Personality traits. Basic chart plus preview any week $14.00. Any month $20.00. Send date, time and place of birth to T. McCarthy, Ast., Box 212, Winthrop Harbor, Illinois 60096.

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MOONSTONE BOOKCELLARS, INC., 2145 Penn. Ave., NW, Washington, DC 20037. WASHINGTON'S only science and mystery specialty bookshop. 202-659-2600.

TOYS, GAMES & ENTERTAINMENT

ATTENTION FANTASY GAMERS! Now there is a magazine expressly for you . . . The Oracle. Send $2.00 for a sample today. Horizon International, Box 27513-B, Salt Lake City, UT 84127.

UNUSUAL BOOKS

THE INTELLIGENCE LIBRARY: Many unique books & official manuals on RESTRICTED subjects — Bugging, Wiretapping, Locksmithing, Covert Investigation, & MUCH MORE. Free brochures, MENTOR, DP, 135-53 No. Blvd., Flushing, N.Y. 11354.

WATCHES, WATCHMAKING & REPAIRING

WATCH and clock repairing books, tools, materials. Free Catalog. North America, Box 79, 1094, Fox River Grove, IL 60021.

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analog
SCIENCE FICTION SCIENCE FACT

CLASSIFIED ADVERTISING ORDER FORM

Send to **ANALOG**
Classified Advertising Department/Suite 1401
380 Lexington Avenue, New York, N.Y. 10017

20 WORD MINIMUM
Only $22.00 for 20 Words or Less
$1.10 each additional word
Capitalized words add—40¢ per word
SAVE 15% WITH 3 CONSECUTIVE MONTHS SAME COPY ORDER

DEADLINE: Copy and payment must be in by the 5th day of the third preceding month for issue in which ad is to appear.

(PLEASE PRINT OR TYPE)

YOUR NAME _____

FIRM (NAME IN AD) _____

ADDRESS _____

CITY _____ **STATE** _____ **ZIP** _____

PHONE: _____ **DATE:** _____

YOUR SIGNATURE _____

_____ Words at $1.10 each $.....

_____ Capitalized word at .40¢ each _____
Total amount for 1 ad $

15% Savings with 3 Consecutive Months Discount

(a) Multiply one ad total $_____ x 3 = $.....
(b) Multiply total amount on above line by × .85
(c) Total amount for 3 ads $

(Example: One 20 word ad $22.00 x 3 months = $66.00 x .85 = $56.10)

$ _____ is enclosed for _____ insertion(s) in the _____ issue(s) _____ Heading

(FOR ADDITIONAL WORDS ATTACH SEPARATE SHEET)

(1) **$22.00**	(2) **$22.00**	(3) **$22.00**	(4) **$22.00**	(5) **$22.00**
(6) **$22.00**	(7) **$22.00**	(8) **$22.00**	(9) **$22.00**	(10) **$22.00**
(11) **$22.00**	(12) **$22.00**	(13) **$22.00**	(14) **$22.00**	(15) **$22.00**
(16) **$22.00**	(17) **$22.00**	(18) **$22.00**	(19) **$22.00**	(20) **$22.00**
(21) **$23.10**	(22) **$24.20**	(23) **$25.30**	(24) **$26.40**	(25) **$27.50**
(26) **$28.60**	(27) **$29.70**	(28) **$30.80**	(29) **$31.90**	(30) **$33.00**

HOW TO COUNT WORDS: Name and address must be included in counting the number of Words in your ad. Each initial or number counts as 1 word: Mark Holly, 380 Lexington Avenue, New York, New York 10017: 7 WORDS. Zip codes are not counted. Phone #: 2 Words. Symbols used as keys are charged for. City or State count as 1 word each: Garden City, New York: 2 words. Abbreviations such as C.O.D., F.O.B., P.O., U.S.A., 7x10, 35mm count as 1 word. (P.O. Box 145 count as 3 words) Webster's International Unabridged Dictionary will be used as our authority for spelling, compound words, hyphens, abbreviations, etc. **Please make checks payable to ANALOG MAGAZINE.**

a calendar of analog upcoming events

1-3 October
ARMADILLOCON 4, SF convention, Bradley Hotel, Austin, Texas. Guests: George Alec Effinger, George R.R. Martin, Howard Waldrop, Leigh Kennedy. $12. Info: Robert R. Taylor, P.O. Box 9612 , Austin TX 78766.

8-9 October
ROVACON 7 (Southwest Virginia SF conference) at Northside High School, Roanoke, Va. Guest of Honor—William Tenn; Art Guest of Honor—Kelly Freas; Special Guest—M.A. Foster. Films, art show, writing workshops, costume contest, etc. RoVaCon Scholarship Awards: Edmond Hamilton/Leigh Brackett Memorial Scholarship for Creative Writing and the Frank Kelly Freas Art Scholarship. All convention proceeds to go to the scholarship fund. Registration—$6 at the door. Info: RoVaCon, Box 117, Salem VA 24153-0117. Send S.A.S.E. 703-389-9400 after 5 P.M. and weekends (no collect calls).

8-11 October
LASTCON TOO (Albany-area SF conference) at Ramada Inn, Albany, N.Y. Guest of Honor—Wilson Tucker; Fan Guest of Honor—Leslie Turek; TM—Lee Killough. Registration—$17 until 22 September, $20 at the door. Info: LASTcon Too, c/o LASTSFA, Box 13-002, Albany NY 12212.

8-11 October
PROJECT STARCAST (multi-media conference) at Harrogate Exhibition Centre, Harrogate, U.K. Registration—£25. Info: Project Starcast, Third Floor, 121 Princess Street, Manchester UK M1 7AG.

9-10 October
OCTOCON IV (California SF conference) at El Rancho Tropicana, Santa Rosa, Cal. Guest of Honor—Roger Zelazny; Artist Guest of Honor—Ralph McQuarrie. Info: Spellbinders, Inc., Box 1824, Santa Rosa CA 95402.

12-13 October
Seventh Conference on Local Computer Networks (IEEE CompSoc) at Minneapolis, Minn. Info: Rick Tett, Program Chairman, 4425 North Victoria Street, Shoreview MN 55122. 612-484-7611.

30-31 October
FIFTH EDITION: THE BASH (Boston-area Star Trek conference) at the Holiday Inn, Randolph, Mass. Guests—Hal Clement and Shirley Maiewski. Info: BSTA, Inc., Box 1108, Boston MA 02103-1108.

1-5 September 1983
CONSTELLATION (41st World Science Fiction Convention) at Baltimore Convention Center, Baltimore, Md. Guest of Honor—John Brunner; Fan Guest of Honor—Dave Kyle; TM—Jack Chalker. Registration—$10 supporting at all times. Attending—$20 until 30 June 1982, more thereafter. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition, the works. Join now and get to nominate and vote for the Hugo Awards and the John W. Campbell Award for Best New Writer. Info: ConStellation, 41st World Science Fiction Convention, Box 1046, Baltimore MD 21203.

—Anthony Lewis

Items for the Calendar should be sent to the Editorial Offices five months in advance of the issue in which you want the item to appear.

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Explore new worlds beyond the limits of time and space.

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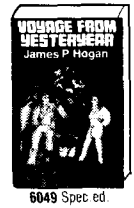
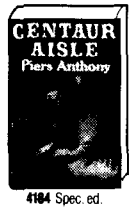


6049 Spec. ed.

†**8920** Spec. ed.

5611 Pub. ed. $13.95

8995 Spec. ed.



4184 Spec. ed.

9001 Pub. ed. $17.95

8979 Spec. ed

6221 Comb. pub. ed. $23.85

8611 Pub. ed. $12.95

2139 Spec. ed.

0497 Nonfiction. Pub. ed. $14.95

8730 Homeworld; Wheelworld; Starworld. Spec. ed.

6197 The Riddle-Master of Hed; Heir of Sea and Fire; Harpist in the Wind. Comb. pub. ed. $24.85

Take any 5 for $1 WITH MEMBERSHIP.

SEE OTHER SIDE FOR ADDITIONAL SELECTIONS.

Note: Prices shown are publishers' edition prices.

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How the Club works:

When your application for membership is accepted, you'll receive your 5 books for only $1 (plus shipping and handling). You may examine them in your home and, if not completely satisfied, return them within 10 days—membership will be cancelled and you'll owe nothing.

About every 4 weeks (14 times a year), we'll send you the Club's bulletin, *Things to Come*, describing the 2 coming Selections and a variety of Alternate choices. In addition, up to 4 times a year you may receive offers of special Selections, always at low Club prices. If you want the 2 Selections, you need do nothing; they'll be shipped automatically. If you don't want a Selection, prefer an Alternate, or no book at all, just fill out the convenient form always provided and return it to us by the date specified.

We allow you at least 10 days for making your decision. If you do not receive the form in time to respond within 10 days and receive an unwanted Selection, you may return it at our expense.

As a member you need take only 4 Selections or Alternates during the coming year. You may resign any time thereafter or continue to enjoy Club benefits for as long as you wish. One of the 2 Selections each month is only $3.98. Other Selections are slightly higher, but always much less than hardcover publishers' editions—up to 65% off! A shipping and handling charge is added to all shipments. Send no money now, but do mail the coupon today!

SCIENCE FICTION BOOK CLUB

Dept. FR-154, Garden City, N.Y. 11530

I want the best SF in or out of this world! Please accept my application for membership in the Science Fiction Book Club. Send me the 5 books I have numbered in the boxes below, and bill me just $1 (plus shipping and handling). I agree to the Club Plan as described in this ad. I will take 4 more books at regular low Club prices in the coming year and may resign any time thereafter. SFBC offers serious works for mature readers.

1.	2.	3.	4.	5.

Mr.
Ms. _____
(Please print)

Address _____ Apt. # _____

City _____

State _____ Zip _____

If under 18, parent must sign. _____

The Science Fiction Book Club offers complete hardbound editions sometimes altered in size to fit special presses and save you even more. Members accepted in U.S.A. and Canada only. Canadian members will be serviced from Canada. Offer slightly different in Canada.

12-S231 C

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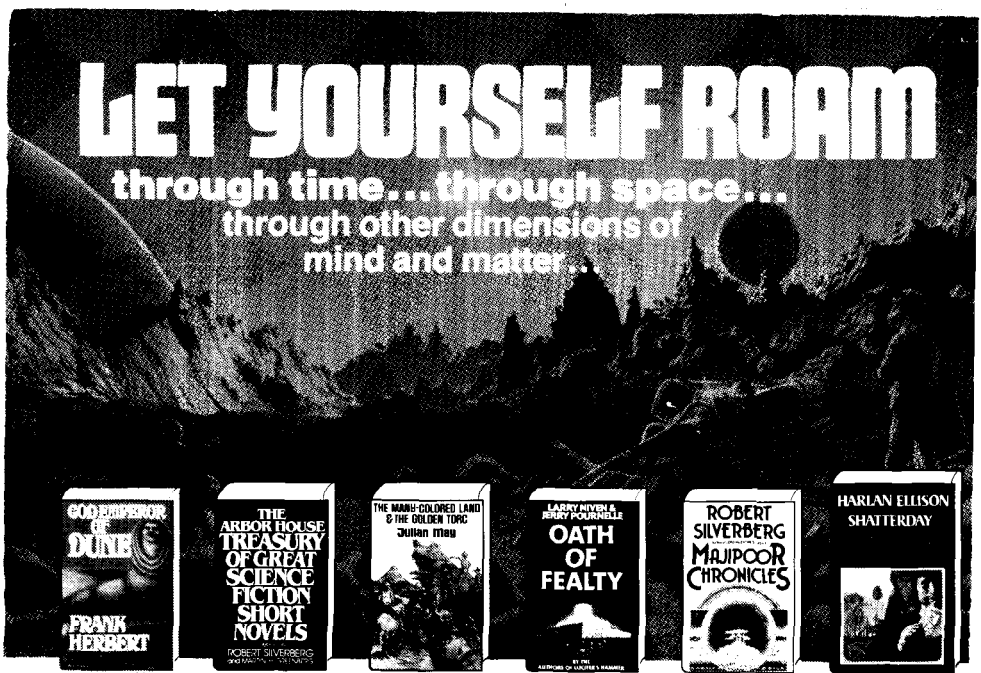
LET YOURSELF ROAM

through time... through space... through other dimensions of mind and matter...



1750 Pub.ed.$12.95

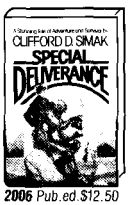
9076 Pub.ed.$19.95

***2840** Comb.pub.ed. *$26.90*

7021 Pub.ed.$13.95

***7955** Pub.ed.$12.95

***0844** Pub.ed.$12.95



2006 Pub.ed.$12.50

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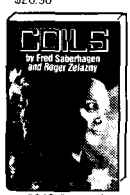

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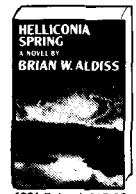

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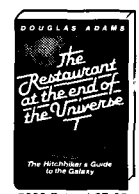

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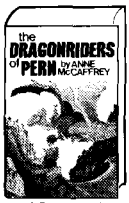

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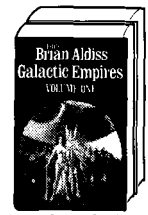

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